















THE UNIVERSITY OF ALBERTA

INTERREGIONAL FEED GRAIN MOVEMENT

BY

RICHARD C. BAILEY

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF  
MASTER OF SCIENCE

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

EDMONTON, ALBERTA

SPRING, 1972



Digitized by the Internet Archive  
in 2017 with funding from  
University of Alberta Libraries

<https://archive.org/details/bailey1972>

## ABSTRACT

The Canadian markets for feed grains are highly complex. It is thus difficult to measure objectively the performance of any one segment. The non-board market for feed grains in the prairie provinces is a major element of the feed grains system. The relation of livestock and poultry feed demands to production and to exports is a major factor in the stability of feed grains markets.

This study presents supply and disposition data for feed grains in the Designated Area. These are used to specify interregional grains movements. The volumes and direction of minimum movements under various specified models are derived from this data. Relative regional price levels of grains are determined, and the effects of interprovincial restriction of grain transportation on grain prices are estimated.

Large amounts of feed grains were transported within the prairies to support expanding livestock production. The analysis indicated that from time to time it was necessary and reasonable to transport feed grains across provincial borders. Restriction of grains movement, if enforced, would necessarily have had a harmful effect on the livestock industry. A distortion of relative price levels in the affected areas would have resulted. A critical lack of market information available to producers also affected interregional trade. The analysis provided evidence that the restrictions cannot be justified by economic criteria.



## ACKNOWLEDGEMENTS

In the preparation of this thesis I have drawn upon advice and encouragement from many individuals. I am primarily indebted to Dr. Murray Hawkins for his advice, guidance, and interest in my work. To Murray a very special thanks. This study also benefitted from the help and comments of Dr. Mel Lerohl and the advice of Dr. J.J. Richter and Dr. M.M. Veeman.

I am also grateful for the help and advice of many others. The comments and information provided by trade personnel and the cooperation of the editors of the papers distributing the questionnaire were valuable and appreciated.

Financial support for this study was provided by the Economics Branch of the Canada Department of Agriculture under the Extramural Research Program.

In addition I am grateful to Miss Susan Moisey for a fine job of typing and organizing this thesis, Mr. Claire Shier for his help in programming and Mrs. Kay Hohn for lending polish to the final draft. I also wish to thank my family and friends all of whom helped in several ways. Although bachelors may have the advantage in entering Graduate Studies, it is difficult to understand how they ever manage to complete the program.





## TABLE OF CONTENTS

	Page
ABSTRACT . . . . .	iii
ACKNOWLEDGEMENTS . . . . .	iv
LIST OF TABLES . . . . .	vii
LIST OF FIGURES . . . . .	viii
CHAPTER	
I      INTRODUCTION . . . . .	1
Objectives	2
Hypothesis	3
Scope and Methodology	3
Limitations of the Analysis	4
Organization of the Study	5
II     THE DEVELOPMENT OF FEED GRAINS POLICY . . . . .	6
The Inception of the Canadian Wheat Board	6
Price Supports	7
Feed Freight Assistance	8
The Oats and Barley Equalization Plan	8
The Inception of Compulsory Board Marketing	11
Present Feed Grains Policy	16
III    LITERATURE REVIEW . . . . .	19
Survey of Canadian Studies	19
Results of a Questionnaire to Producers	25
Interviews with the Trade	26
A Review of the Development of Spatial Analysis	29
IV     PRESENTATION OF THE ECONOMIC MODEL . . . . .	40
Spatial Organization	40
Specification of Demands	43
Adjustments to Regional Demands	46
Regional Supply	46
Transportation Problem	47
The Mathematical Model	49



CHAPTER	Page
V ANALYSIS OF FEED GRAIN MOVEMENTS . . . . .	54
Specific Model Formulations	54
Inventory	77
Interpretation of Results	77
Pricing: Results of Dual Solution	79
Summary of Analysis	80
Weaknesses	83
VI SUMMARY AND CONCLUSIONS . . . . .	85
Recommendations	88
BIBLIOGRAPHY . . . . .	91
APPENDIX A . . . . .	96
APPENDIX B . . . . .	98
APPENDIX C . . . . .	101
APPENDIX D . . . . .	114
APPENDIX E . . . . .	118



## LIST OF TABLES

Table		Page
1.	Comparison of Exports and Animal Feed Use of Canadian Grains . . . . .	2
2.	Supply and Disposition: Model I . . . . .	57
3.	Regional Allocation: Model I, 1967-68 . . . . .	58
4.	Regional Allocation: Model I, 1968-69 . . . . .	59
5.	Regional Allocation: Model I, 1969-70 . . . . .	60
6.	Supply and Disposition: Model II . . . . .	63
7.	Regional Allocation: Model II, 1967-68 . . . . .	64
8.	Regional Allocation: Model II, 1968-69 . . . . .	65
9.	Regional Allocation: Model II, 1969-70 . . . . .	66
10.	Supply and Disposition: Model III . . . . .	68
11.	Regional Allocation: Model III, 1967-68 . . . . .	69
12.	Regional Allocation: Model III, 1968-69 . . . . .	70
13.	Regional Allocation: Model III, 1969-70 . . . . .	71
14.	Supply and Disposition: Model IV . . . . .	73
15.	Regional Allocation: Model IV, 1967-68 . . . . .	74
16.	Regional Allocation: Model IV, 1968-69 . . . . .	75
17.	Regional Allocation: Model IV, 1969-70 . . . . .	76
18.	Aggregate Inventory Accumulation . . . . .	77



## LIST OF FIGURES

Figure	Page
1. Trading Area with a Central Market . . . . .	33
2. Decentralized Market, Schedule 1, Producer Determined Delivered Prices . . . . .	35
3. Decentralized Market, Schedule 2, Consumer Determined f.o.b. Prices . . . . .	35
4. Decentralized Market, Schedule 3, Producer Determined Delivered Prices . . . . .	35
5. Decentralized Market, Schedule 4, Consumer Determined Delivered Prices . . . . .	36
6. Regional Demarcation of Study Area . . . . .	42





## CHAPTER I

### INTRODUCTION

In 1948, the Canadian Wheat Board Act was amended to permit the Canadian Wheat Board (the Board) to purchase oats and barley. The markets for oats and barley, however, differed from the market for wheat. Large quantities of grain were consumed within the Designated Area<sup>1</sup> for the production of livestock. Markets for domestic use were thus competing with export markets when oats and barley were in short supply.

To ensure that oats and barley would move through Board marketing channels, regulations were included in amendments to the Canadian Wheat Board Act prohibiting movement of grains across provincial borders within the Designated Area. The governments of the three prairie provinces then passed conjoint legislation requiring that all oats and barley for intraprovincial trade be handled by the Board. Thus the Board controlled interprovincial movement of grains and administered the prices at which Board grains were traded within the Designated Area.

The non-Board feed grains market, which is also affected by Board controls on interprovincial movement, is the major market for feed grains in Western Canada (Table 1).

---

<sup>1</sup>The Designated Area refers to the provinces of Manitoba, Saskatchewan and Alberta and to the Peace River area of the province of British Columbia as defined in Section 2 of the Canadian Wheat Board Act [Statutes of Canada, 1970, Chapter C12].



Table 1

## COMPARISON OF EXPORTS AND ANIMAL FEED USE OF CANADIAN GRAINS

Crop Year		Wheat	Oats	Barley
		(Millions of Bushels)		
1966-67	exports	515.3	4.8	58.5
	animal feed	52.8	362.0	177.5
1967-68	exports	336.0	3.5	41.4
	animal feed	65.7	308.2	176.5
1968-69	exports	305.8	2.7	26.4
	animal feed	57.3	282.8	196.5
1969-70	exports	346.5	5.2	88.3
	animal feed	98.2	330.0	254.4

Source: Dominion Bureau of Statistics, Grain Trade of Canada,  
Catalogue No. 22-201 (Ottawa: Queen's Printer, various years).

Until recently, export markets for Canadian oats and barley have not been significant. Expanding markets for feed grains within the prairies resulted in critical examination of the restrictions on grains movement in this area. The purpose of this study is to identify and examine some of the effects of these controls on the prairie feed grains market. A more thorough understanding of the feed grains market will help producers in projecting feed grain prices and in assigning acreage quotas

## Objectives

The objectives of this study were:

1. To outline the structural characteristics of the feed grains market and review the development of feed grains policy.



2. To specify a technique for analyzing the impact of interprovincial barriers on commodity movement.

3. To study the effects of interprovincial restriction on feed grains movement.

### Hypothesis

It was hypothesized that the restriction of the movement of feed grains interprovincially within the Designated Area enhanced market efficiency in the prairie feed grains markets and was, therefore, beneficial to prairie agriculture.

### Scope and Methodology

Measurement of interregional feed grain movements was analyzed on a descriptive foundation. The development of feed grains marketing as defined by legislative changes was also reviewed and is presented with an interpretation of the legislation and a description of the immediate effects of specific amendments to the Statutes and the Orders-in-Council. Studies related and specific to feed grains marketing were summarized to consolidate previous knowledge in this field. A review of the literature and of feed grains policy provided a basis for analysis and discussion of the effects of the restrictions. Two additional descriptive segments were included. A short questionnaire surveyed producers' opinions and reactions concerning effects of the restrictions on grain movement. Interviews with various personnel from the grain trade provided valuable information about the effects of the restrictions.



This study measured some of the impact of feed grains policy and its effect on market efficiency. Simulation of the prairie feed grains market without restriction on feed grains movement was carried out by means of a transportation model. The model was used to provide the flows of feed grains and to illustrate regional price differentials across the prairie provinces. The study included only feed grains and applied to the Designated Area exclusive of the Peace River region. The Area was separated into discrete units of space as dictated by specified criteria. Analysis of regional feed grain prices using the structural characteristics of the model could not be included because of data limitations.

The above format for the analysis provided a balance between normative-logical and positive-quantitative analysis. The positive-quantitative transportation model and the descriptive section provided a joint basis for discussion of the effects of the policy. Conclusions and recommendations were based on both forms of analysis.

#### Limitations of the Analysis

The prairie feed grains market is a complex, poorly defined, largely unresearched sector of agriculture [Marret, 1970, p.20]. Any study of this market must necessarily have weaknesses and a limited scope. This study has several weaknesses:

1. Equilibrium simulation studies are subject to a series of rigid assumptions that do not completely reflect reality. The data requirements necessary to solve the model are large, resulting in errors which may be increased by the necessary adjustments to the model.





2. The price series used in this study are averages and apply to farm-to-feed mill sales only. There are also significant price information limitations because of incomplete collection; for example, data on farm-to-farm sales is not available.

3. The complexity of the analysis made it necessary to restrict the study to the Designated Area and to feed grains. Quota sales to the Board are not considered because Board grains are not generally used for feeding purposes; however, interregional movements for quota sales are specified when they occur.

### Organization of the Study

Chapters Two and Three of the study provide background information for the analysis. A delineation of feed grains policy with an historical review of legislation relevant to feed grains marketing comprise Chapter Two. A review and short summary of research in Canadian feed grains marketing and a description and critique of the transportation model are included in Chapter Three. A description of the theory and technique of analysis is presented in Chapter Four. This chapter explains the functional form of the transportation model as applied to the feed grains sector. The results of the analysis within the context of the previous chapters appear in Chapter Five. Chapter Six presents the results of the analysis related to feed grains policy. The implications of the results of this study are articulated and organized in a policy framework. The study concludes with a summary of findings and recommendations based on these results.



## CHAPTER II

### THE DEVELOPMENT OF FEED GRAINS POLICY

#### The Inception of the Canadian Wheat Board

The initial Wheat Board Act passed in 1935 was a comprehensive bill formalizing a Wheat Board and the activities carried out by several agencies and boards before 1935. The Wheat Board and centralized marketing of wheat developed from previous government policy and programs. The original Canadian Wheat Board Act was amended ten times between 1935 and 1971. In addition, changes in grains policy were enacted by Orders-in-Council.

The main purpose of the Board as defined in the Canadian Wheat Board Act of 1935 [Statutes of Canada, 1935, Chapter 53] was to act as an intermediary between the farmer and the international wheat market. This legislation provided for a voluntary marketing agency that could distribute its profits to the producer. The Board was required under Section 8 to act in conjunction with other agencies in the trade. Also under Section 8 the Board was empowered to investigate dealings of the Grain Exchanges affecting interprovincial or international trade in Canadian grains. In practice the Board made full use of the facilities of the Winnipeg and Vancouver Grain Exchanges. The terms of the Act could, with the approval of the Governor in Council, be extended to barley, oats, rye, and flax. This provision, however, was repealed by the 1939 amendments to the Act [Statutes of Canada, 1939, Chapter 39]. Section 9 and 10, which were not proclaimed,



allowed for the control of all licensed elevators and for the control of grain movement to and from these elevators.

The involvement of the Canadian Wheat Board in the marketing of oats and barley developed as a result of several measures taken between August of 1942 and July of 1949. These changes included both amendments to the Canadian Wheat Board Act and numerous Orders-in-Council specifying instructions to the Board.

### Price Supports

During wartime greater production of feed grains was desirable in order that a larger livestock population could be supported and additional grain exports could be made. To further these ends the Government of Canada, under authority of Order-in-Council P.C. 1801, March 9, 1942, instructed the Board to support the prices of oats and barley paid to producers in the Designated Area. Price supports were a feature of government policy carried out by the Board from August 1, 1942, to July 31, 1949, at which time the Board began marketing oats and barley as a normal function. The support level was maintained through purchase and sale of barley futures or cash barley and oats futures or cash oats. The Board manipulated the market so that the price of 2 c.w. oats in store at the Lakehead was supported at 40¢ per bushel and 1 c.w. barley in store at the Lakehead was supported at 60¢ per bushel. Discounts for other grades were also established. These price levels were maintained until March 17, 1947. On only two occasions, in the 1942-43 crop year and the 1944-45 crop year, was support carried out. During the 1947-48 crop year, price ceilings



were maintained from August 1, 1947, to October 21, 1947. An adjustment to producers of 5¢ per bushel on oats and 11¢ per bushel on barley was paid to producers who had sold oats or barley to a grain dealer during the period from August 1, 1947, to October 21, 1947. By authority of Order-in-Council P.C. 3395, the government authorized the Board to make these payments from funds of the Commodity Prices Stabilization Corporation.

#### Feed Freight Assistance

Another policy designed to promote livestock production in Canada was the feed freight assistance policy instituted in 1941. By several Orders-in-Council [Kerr, 1966, pp. 6-13], the federal government authorized partial payment for the transportation costs incurred in shipment of feed grains to British Columbia and Eastern Canada. This policy has been periodically revised, largely because of changes in the rate of subsidy to various areas, and has remained in effect until the present time.

#### The Oats and Barley Equalization Plan

In addition to price supports, equalization fees were assessed on oats and barley. On April 6, 1943, the government announced the assessment of equalization fees against export permits for oats and barley under authority of Order-in-Council P.C. 4450 on June 1, 1943. This fee was based on the difference between domestic and export prices less allowances for transportation, forwarding, and other costs. This program was initiated because oats and barley prices in the United States were rising while Canadian prices were subject to ceilings of





51-1/2¢ per bushel for oats and 64-3/4¢ per bushel for barley basis in store Lakehead or Vancouver. The difference in price was thus reflected back to the producer on the basis of commercial marketings.

On November 18, 1943, by Order-in-Council P.C. 8898, a government guarantee of equalization funds and advance payment of these funds to producers was initiated. For the 1943-44 crop year the advance payment was 10¢ per bushel for oats and 15¢ per bushel for barley. Payments were made on authorized farm-to-farm transactions [For a description of authorized transactions see Canada Gazette, Statutory Orders and Regulations, 1946, Volume II, No. 6, p. 234.] in addition to normal deliveries. This was necessary in order that increased quantities of oats and barley could be used domestically for feeding purposes. Thus the equalization accounts could show surplus funds only if supply exceeded domestic use. In this case the surplus was distributed to producers having received advance payments from the Board on the oats or the barley fund as the case might be. Deficits in the funds were made up by the Government of Canada.

Significant changes in the Board's marketing policy were enacted in 1943. Included in these changes were the discontinuance of trading in wheat futures by the Board and the acquisition of all stocks of wheat in commercial position in Canada [Canada War Orders and Regulations, Vol. III, No. 7, p. 355]. These stocks of wheat were partially used for Mutual Aid.

During the 1944-45 crop year the equalization plan was maintained as in the previous (1943-44) crop year under Order-in-Council P.C. 5998, July 31, 1944. The ensuing crop year was characterized by



a shortage of feed grains. Order-in-Council P.C. 2550, dated April 12, 1945, provided for extension of the equalization plan for the crop year. A subsequent Order-in-Council P.C. 6238 amended the regulations of the plan, increased advance payments on barley to 20¢ per bushel, and prohibited maltsters from paying a premium on malting barley. The 20¢ premium covered the entire crop year 1945-46. This resulted in a deficit in the barley fund in excess of fourteen million dollars [Canadian Wheat Board, n.d., p. 111] reflecting the small volume of barley released for export by the Agricultural Supplies Board.

For the crop year 1946-47 the advance equalization payment for barley reverted to 15¢ per bushel under Order-in-Council P.C. 3222 of July 30, 1946. Malting barley premiums of up to 5¢ per bushel were allowed. The Agricultural Supplies Board continued to limit exports of grains to maintain domestic supplies. Exports were again limited by the Agricultural Supplies Board of the Department of Agriculture in the 1947-48 crop year. Advance equalization payments were not made.

These and subsequent changes in policy were formalized in 1947 amendments to the Act [Statutes of Canada, 1947, Ch. 15]. Many of the above changes had been enacted by Order-in-Council under the War Measures Act. Thus postwar statutory changes were necessary. The resulting statute was to be in force until 1950. An important aspect of the 1947 statute was the formation of a five-year pool period from 1945 to 1950 in place of the previous annual pools. It was also at this time that the Board assumed control over export marketing of barley and oats.



### The Inception of Compulsory Board Marketing

At midnight March 17, 1947, the Board took possession of all oats and barley in commercial position in Canada under authority of Order-in-Council P.C. 1292 of April 3, 1947. Under this operation the Board acquired thirty (29,868,936) million bushels of oats and 21 million (20,992,324) bushels of barley. The Board sold these stocks under the condition that any net profits or losses resulting from the sale would be assumed by the government. A surplus of \$14,723,274 was paid to the Government of Canada. The operation thus provided a means to change from a lower to a higher price support level and price ceiling level. The main features of Order-in-Council P.C. 1292 [Canadian Wheat Board, n.d., p. 112] were:

1. Advance equalization payments on oats and barley that were begun August 1, 1943, were discontinued as of March 18, 1947.
2. The ceiling price on domestic oats and barley was revised. The price levels of 51-1/2¢ per bushel for oats and 65¢ per bushel for barley established in 1941 were raised to 64-3/4¢ per bushel for oats and 93¢ per bushel for barley basis in store at the Lakehead or Vancouver. As a transitional measure, an adjustment payment of 10¢ per bushel for barley was provided on all barley delivered between August 1, 1946, and March 17, 1947. This, in addition to the 15¢ advance equalization payment, approximated the margin between the old and new ceiling prices for barley. No further adjustments was made for oats.
3. Support prices for oats and barley were revised. The original support levels of 45¢ per bushel for oats and 60¢ per bushel for barley were established in 1942. As of March 18, 1947, these



support prices were increased to 62-1/2¢ per bushel and 90¢ per bushel respectively. Market prices remained above these new levels from March 18, 1947, to July 31, 1949. At the latter date, support prices were removed.

4. The Board became the sole exporter of Canadian oats and barley.

5. All oats and barley in commercial position became the property of the Board and were to be disposed of by the Board.

The Board thus assumed all functions of marketing oats and barley through commercial channels. Equalization operations were terminated July 31, 1949. At that time the Board assumed marketing of oats and barley on an equivalent basis with wheat. Also at this time the Board gained control of all transactions in feed grains exclusive of farm-to-farm sales.

Two major amendments were made to the Act in 1948 [Statutes of Canada, 1948, Chapter 4]. The act was amended to provide for the extension of the terms of the Act to apply to Board marketing of barley and oats given approval of the Governor in Council. The Act was also amended to control the interprovincial movement of wheat products in addition to wheat *per se* and to control the movement of grains delivered under quota into elevators and to forwarding facilities.

The extension of the Act to barley and oats for the 1949-50 crop year was followed by the proclamation of legislation by the governments of Alberta, Saskatchewan, and Manitoba at the request of the Minister of Trade and Commerce for regulating intraprovincial marketing of grains. These Acts were passed, but not proclaimed, immediately prior to the institution of compulsory Board marketing of barley and oats.







Each of the provincial acts provides for regulation of the marketing of grains locally within the province but does not apply to interprovincial trade. The Manitoba legislation [Revised Statutes of Manitoba, 1965, Chapter C140] provides for the regulation of the marketing of oats and barley and oat products within the province. Under Section Four the sale or purchase or the agreement to sell or purchase Manitoba coarse grain is prohibited unless the transaction is on account of the Board. Exceptions to this are the sale or purchase of grains by a producer of grains or livestock for delivery within the province. Any contracts in contravention of this Act are void. The Alberta Coarse Grain Marketing Control Act [Revised Statutes of Alberta, 1955, Chapter 49] is identical to the Manitoba Act except for the inclusion of a section specifying persons prohibited from acting as sales agents. The list includes operators of feed mills, flour mills, elevators, and packing plants; and track buyers, grain merchants, feed merchants, livestock merchants, commercial feeders, stockyard companies, livestock commission firms, and truckers, any of whom are not agents of the Board. Producers are prohibited from appointing any of the above persons as agents or selling grain to them [Statutes of Alberta, 1951, Chapter 12, Section 2]. The Saskatchewan legislation, entitled the Saskatchewan Grain Marketing Control Act [Revised Statutes of Saskatchewan, 1965, Chapter 241, p. 3970], was revised in 1953 to include all grains and grain products in place of only barley and oats and products thereof [Revised Statutes of Saskatchewan, 1953, Chapter 219, Section 2, 3, 4, 5, 6, 7, and 8]. This Act provides control over the marketing of all grains identical with that specified in the



Manitoba legislation. By authority of Order-in-Council P.C. 3713 of July 20, 1949, the CWB Act was extended to include barley and oats for the 1949-50 crop year. The Act has similarly been extended by Order-in-Council for each crop year.

At the time of the extension of Board marketing to barley and oats, opinion had been expressed by trade personnel urging that grains be allowed to move freely across provincial borders within the Designated Area. In reply to this proposal the solicitor for the Board made the following submission:

In drafting the 1947 amendments to the Canadian Wheat Board Act it was necessary to devise a scheme of control which it was within the competence of Parliament to enact. It was realized that each prairie province produced a surplus of cereal grains, and in the course of the interprovincial and export trade, that surplus moved into another province. Parliament does not have the power to control sales wholly within a province; and consequently, some means had to be found in the scheme of the Statute to force grain into the hands of the Board. The scheme which was enacted in the Statute prohibits the movement of grain interprovincially except by or with the permission of the Canadian Wheat Board. This has the effect that grain destined for the interprovincial or export market must be sold to the Board in order that it may be moved out of the province . . . [CWB, 1970, pp. 4-5].

During the 1949-50 crop year, for the first time all commercial marketings of oats and barley exclusive of farm-to-farm transactions were vested in the Board. Price guarantees equal to the price support levels under previous policy were established by the federal government. By Order-in-Council P.C. 3713, July 20, 1949 [Canada Gazette Part II, Statutory Orders and Regulations, 1947, pp 1501], which included extension of the Act to include oats and barley, initial prices basis in store at the Lakehead were set. As of August 1, 1949,



the Board initiated the marketing of oats and barley through its agents. Prices were quoted for the principal grades of oats and barley basis in store at the Lakehead. Prices were also set for the country points in the Designated Area and for British Columbia based on Lakehead quotations.

Implicit in these changes was the requirement that all barley and oats traded by the Board and its agents was subject to quota restrictions. For example, producer deliveries to feed mills for subsequent resale as livestock feed were entered in the producer's permit book. All transactions took place at prices dictated by the Board. These prices were based on Lakehead prices and not a negotiated or competitive price established by local buyers and sellers of barley and oats.

Several amendments to the Act were necessary during the 1949-50 crop year. Changes in the Act (1935) included the institution of annual pool periods after the expiry of the former five-year pool (1945-1950) and clarification of "works for the general advantage of Canada." This revised definition included flour mills, feed mills, feed warehouses, and seed cleaning mills in addition to elevators. As an appendix to the Act, a schedule of all facilities registered with the Board as works for the general advantage of Canada was included. This listing included the majority of feed mills within the Designated Area.

There have been no amendments to the Act of direct relevance to feed grain marketing since the 1949-50 revisions. There was, however, a significant change in Board policy with regard to feed grains marketing in 1960. As a result of pressure from the operators of feed mills,



quota and price restrictions on grain traded by feed mills were dropped. The policy instituted in the 1949-50 crop year was never practiced by the feed industry. Court actions were initiated by the Board in 1957 and 1958 to enforce the policy, and a large backlog of cases resulted. The cases were contested in all courts of appeal, and finally the matter was referred to the Standing Committee on Agriculture and Colonization. Hearings were held, and the Committee recommended removal of the restrictions. This change was instituted by the Board in November of 1960 under the provisions of Section 16 of the Act [Revised Statutes of Canada, 1952, Vol. II, Chapter 44].

#### Present Feed Grains Policy

Since 1942, the Board has been involved in the commercial marketing of barley and oats in varying capacities. Various forms of price control led to the control of commercial movements in March of 1947. Later that year the Act was amended to allow the Board to set quotas for the delivery of wheat, oats, barley, rye, and flaxseed and to control interprovincial movement of wheat products.

In 1949, the Board initiated the interprovincial and export marketing of oats and barley as part of its normal operations. This extension of the powers of the Board included control of sales of oats and barley excepting farm-to-farm sales made possible by the proclamation of provincial legislation providing for intraprovincial control of feed grains marketing. Amendments to the Act in 1950 provided a clear definition of "works for the general advantage of Canada," which included feed mills and feed warehouses in addition to elevators.







The feed mills specified in a schedule contained in the amendments were designated as agents of the Board and were required to trade only in Board grains. This later proved to be unworkable, and in 1960 feed mills were again allowed to trade in non-Board grains. Under agreement with the Board the mills are required to:

1. Purchase grain only from permit holders;
  2. Record the volume of grain purchased from permit holders appropriately in the permit book;
  3. Sell grain purchased from permit holders only in processed form and within the province in which the mill is located;
  4. Post the prices paid to producers by the mills on a continuous basis;
  5. Submit a record of purchases of all grains to the Board.
- Separate accounts must be kept for grains shipped out of the province in which the mill is located. This grain must be handled as by an agent of the Board [Rural Feed Mills Association, 1970].

Only a small proportion of feed grains is traded through licensed mills. The remainder is traded in farm-to-farm and farm-to-feedlot transactions. The Board requires that grain not be transported across provincial borders and enforces this regulation through the services of the Royal Canadian Mounted Police.

Trade in non-Board grains within the prairies is not carried on in an orderly manner. There is no reliable price information service for the various feed grains nor means of identifying local buyers and sellers other than by personal communications. Only a small proportion of non-Board grains is traded through licensed feed mills. These



transactions are recorded in the producer permit books. The remaining non-Board grains are traded at prices that may vary substantially from region to region and within regions depending upon local conditions. In many cases truckers act as agents between buyers and sellers. In general, truckers act as grain traders in a larger area than do individual producers. The market is, however, not easily defined.

In Chapter Three a survey of studies relevant to feed grains marketing is presented. This is followed in Chapters Four and Five by the presentation of supply, disposition, and interregional movements of feed grains in the prairie non-Board market.



## CHAPTER III

### LITERATURE REVIEW

During the period from 1969 to the present, the markets for prairie feed grains have been viewed as an increasingly important aspect of grains marketing in general. The first section of this chapter provides a summary of the more recent studies relating to domestic feed grains marketing. The second section provides a basis for the analysis of interregional commodity movements. This survey traces the development of the transportation model from early theoretical works on market equilibrium and location theory.

#### Survey of Canadian Studies

One of the early major studies of Canadian feed grains policy was an analysis of the feed freight assistance policy by Kerr in 1966 [Kerr, 1966]. His analysis of the policy examined its impact on the Canadian economy, Canadian grain markets, and regional livestock production. Kerr traced the policy from its inception in 1941 through to 1964, with a parallel analysis of feed grains policy and a summary of the views of industry leaders. His analysis was based on international trade theory, location theory, and the concept of comparative advantage in an attempt to determine the qualitative effects of the policy. On the basis of his analysis of the various Canadian feed grain markets, Kerr concluded:

1. The stabilization of grain prices in interprovincial and export trade has resulted in the incidence of the price uncertainty



associated with this trade upon the non-quota feed grain markets, and

2. The internal prairie feed grain markets were subject to two important restrictions:

a) The commercial marketing activities for Board grains could not be used, thus reducing the operational efficiency of the marketing system.

b) The restrictions on interprovincial movement of non-quota grains resulted in wide differentials in feed grain prices among provinces in the Designated Area.

Kerr recommended rationalization of the non-quota markets by removal of these two restrictions. He predicted that greater stability in prairie livestock output would result from these changes. The study further indicated that the policy disrupted normal inter-regional trade in feed grains. The result was a distortion of natural comparative advantage in feed grain production. Kerr's analysis applied to the restriction on movement of a commodity by legal means. Restriction may be considered equivalent to a prohibitive tariff, and similar impact will be realized from a restriction as from a tariff. In this case an effect equal to a zero tariff resulted. Kerr concluded that feed freight assistance was not an optimal policy.

A subsequent study, The Benefits and Burdens of Feedgrain Transportation Policy [Lerohl *et al*, 1970], analyzed the effects of the feed freight assistance policy in a Canadian and North American context given:

...the existence of policy in a world of imperfectly functioning markets, especially with barriers and hindrances to trade in grains, and the existence of non-competitive freight rate structures [Lerohl *et al*, 1970, p. 1].





The study examined the regional income effects and changes in trade patterns that would result from alternative programs or policies. The analysis of these programs revealed that freight equalization payments were an essential aspect of feed grains policy, given restrictions on the movement of feed grains, unless more effective means of expanding the Canadian livestock and meat industry could be devised.

A study by the Canada Grains Council [Marret, 1970, p. 30] indicated need for revisions in the prairie feed grain marketing system so that:

1. It responds quickly to changing market conditions of supplies and demands.
2. It re-establishes the confidence of the buyers in the pricing mechanism.
3. It maintains continuity and pressure of supplies in available markets . . . .
4. It works to the satisfaction of both buyer and seller.

The prairie feed grain market was described thus:

. . . the trading in feed grains on the prairies is unsophisticated and occurs directly between the grain farmer and the livestock feed farmer and/or the feed mill, with the order of the day being that the grain grower is in the weak bargaining position. Markets appear quite local with variations in price at any one time occurring not only between provinces but between points within a province [Marret, 1970, p. 20].

The report of the Canadian Grain Marketing Review Committee [Menzies, 1970] did not deal extensively with interprovincial grains movement:

Wheat, barley and oats are Board grains. Except for intraprovincial sales between farmers and users, the Board controls their marketing from the farm gate to the seaport. It is logical as well as in accordance with the wishes of the producers that this should continue [Menzies, 1970, p. 40].



. . . We are left without satisfactory evidence from which to recommend any decisive structural change from the mixed grain marketing system presently operating in Canada [Menzies, 1970, p. 42].

The Report of the Federal Task Force on Agriculture's recommendations for coarse grains marketing indicated:

That the Canadian Wheat Board continue to be responsible for all commercial purchases of barley and oats from the primary producer . . . [Federal Task Force on Agriculture, 1969, p. 131].

The Alberta Wheat Pool supports the restriction of grains movement across provincial borders on the basis that removal of this restriction would result in pressure from livestock feeders in Eastern Canada and British Columbia for complete removal of restrictions on grains movement within Canada [Alberta Wheat Pool, 1970]. The Pool stressed that the problem must be considered in the context of long-range benefits to prairie grain and livestock producers.

The submission of the Canadian Wheat Board to the Standing Committee on Agriculture included an explanation of the illegal movement of grains within the Designated Area [CWB, 1970]. The movement of grain interprovincially was described as inversely proportional to quota delivery opportunities. If grain moved freely through the elevator system then producers were not forced to find alternative markets for their product. The converse of this statement was also true. During the 1968-69 crop year, significant interprovincial movement occurred as the result of the production of large quantities of tough and damp grain. Interprovincial grain movement had occurred at several points within the Designated Area. The Board had attempted to police this movement and had taken court action against the violators



of the Board's regulations whenever possible.

Special circumstances existed with regard to movement of grain from Northern Alberta to the Peace River area of British Columbia. In this case, producers located in Alberta had selected delivery points located in British Columbia with Board permission. The delivery points chosen by these producers were those geographically most accessible to them. Another factor in this movement was the Board's policy of allowing Alberta producers to deliver grain on a non-quota basis to elevators in the Peace River area of British Columbia. In the Board's instructions to the trade, permission to move non-Board grains inter-provincially from Northern Alberta into British Columbia was renewed annually in September of the crop year and expired the following July 31. The quantity of non-Board grain purchased was known by the Board because all deliveries were entered in the producers' permit books.

The Board submission also presented the major criticisms of existing feed grains policy with some of the suggestions for improvements. Criticisms were of two types: those presenting the case for stronger controls and those presenting the case for less control by the Board. The Board stated that less control by the Board was undesirable in that the Board's controls as outlined in the Canadian Wheat Board Act would thereby be reduced. The case for greater control was rejected because of the difficulty of enforcing stricter or more encompassing regulations.

A detailed review of the prairie feed grains market was conducted by the Canadian Federation of Agriculture in 1970 [Carlson, 1970].



A background paper on feed grains policy was prepared by G.C. Carlson from this survey. The document outlined the mechanics of prairie grains marketing, summarized research done on grains marketing, and included a comprehensive exposé and explanation of conditions late in 1969. Based on this information, policy implications and considerations were drawn and research needs specified. The summary of observations included the following:

. . . Feed mill prices tend to reflect the full effects of changes in supply and demand of non-quota grains on the Prairies . . . . The restriction on interprovincial movements of non-quota grain misallocates resources, markets and prices . . . . Interprovincial movement was mainly between Western Saskatchewan and Alberta . . . . Enforcement of farm-to-feed mill and interprovincial trade is the responsibility of the Canadian Wheat Board, according to the terms of the Act [Carlson, 1970, p. 127].

Recommendations included:

. . . Initiate a study re: interprovincial movement of grains within CWB [sic] area, to determine what effect such a policy would have on the Wheat Board's ability to operate effectively . . . [Carlson, 1970, p. 112-120];

and

. . . what is needed . . . is an in depth study . . . with a view to developing a 'package policy' that will serve both the producer and consumer of feed and feed grains . . . [Carlson, 1970, p. 122].

A study entitled Interregional Competition in Canadian Cereal Production [Craddock, 1970] prepared for the Economic Council of Canada provided relative costs of production and equilibrium supply and disposition of grains under various assumptions. The analysis applied to the base year 1966. The analysis provided by Craddock included







specification of interregional grains movement within the prairies. For the crop year 1966-67, interregional movements of barley were indicated for two alternative models [Craddock, 1970, p. 223]. Movements from Southeastern Saskatchewan or Southwestern Manitoba to Southeastern Manitoba were indicated. There were also movements of rye as a feed grain from Southeastern Alberta to Southwestern and North Central Alberta.

No consensus could be obtained from the literature on the usefulness or need for restriction of non-Board grains movement within the Designated Area. Most of the studies summarized did not treat the problem explicitly. There appeared to be both economic and political aspects to the problem but lack of rigorous analysis on either.

#### Results of a Questionnaire to Producers

A questionnaire designed to determine producer opinions on the effects of the interprovincial restriction of grains movement in the Designated Area appeared in several papers printed in the prairies. Five widely circulated papers cooperated with this survey. As a result largely of timing and the content of the questionnaire, the number of replies was not large enough to provide strongly conclusive results. The questionnaire was designed to determine producer opinions on the incidence and importance of the restrictions to Prairie agriculture and to the respondent's particular farm or business. The replies were sorted on the basis of regional demarcation and type of farming operation. A description of the content and results of the questionnaire are included in Appendix E.



Many of the questionnaires had comments attached, most of which indicated concern about the pricing of feed grains on the non-Board market. Several producers stated that the restrictions tended to distort prices because of the absence of reliable price quotations in the more distant markets for their feed grains. Producers felt that this hindered them in planning their operations and made price prediction very difficult, even on a quarterly basis. Other producers cited the use of fat cattle as a substitute for transportation of grains as an undesirable effect of the restrictions.

#### Interviews with the Trade

In order to obtain information on the reasons for initial institution of the restrictions on interprovincial grains movement and the historical and current effects of the restrictions, extensive interviews were carried out with officials of various agencies, companies, and organizations in the grain trade; farm organizations and farm groups; feed companies and feed mill operators; and farmers and truckers.

Opinions of those interviewed were generally diversified. The objective of the restrictions as explained by officials of the Canadian Wheat Board and the Grains Group was to force grain into the marketing channels of the Board. By maximizing Board access to prairie grains through the quota system, the Board's ability to meet forward sales commitments was seen to be enhanced. The officials indicated a desire to move as much grain as possible into Board marketing services.

None of the other grain industry personnel interviewed could cite objectives of the restrictions. In one case the restrictions were



cited as a necessary aspect of grains marketing because the Board needed to control the movement of grain. This control was seen as a means of "protecting" producers from selling non-Board grains too cheaply. It was noted that the restriction of grains movement conflicted with the Board marketing system goal of equity of delivery opportunities. As Saskatchewan producers were denied access to Alberta feed grain markets, the restrictions were not consistent with this major goal.

Local movements of grain across borders and large-scale movements over greater distance were distinguished. In most cases the local movement around trading centers such as Lloydminster was considered to be a clear case for freedom to move grains even when movement throughout the entire area was rejected. As a general rule, the Alberta-Saskatchewan border was the major consideration, and movements were noted at points all along this boundary.

The effect of movement of grains on non-Board feed grain prices could not be specified. Because the volume of grain moving across provincial borders was not known, a price impact<sup>\*</sup> could not be accurately specified, although widely ranging opinions were offered. A general consensus that price reductions would occur in deficit areas of Alberta was noted. Two conflicting viewpoints were presented:

1. The restrictions serve to lower prices in Saskatchewan relatively more than they raise them in Alberta. Because movement is illegal and subject to court action, the risk in movement is paid for by the producer, who thus sells the grain at a discount. Removal of



the restrictions would tend to raise prices in Saskatchewan in a purely free market relation to the Alberta market. In other words, Saskatchewan prices would be bolstered through the removal of a risk factor and improved information. Alberta prices would not be lowered proportionally. The Alberta market would be affected only in the area in which Saskatchewan grain could be moved as constrained by transportation costs. Only small quantities of Saskatchewan grain were sold at extremely low prices; thus Alberta prices could be reduced only slightly by Saskatchewan grain.

2. The other argument as stated was that because Alberta is largely self-sufficient in feed grains, movements of grain into Alberta could depress prices significantly, thus reducing the income to producers of feed grains.

Fines currently being imposed for illegal movement of grain were also discussed. Interviews with truckers engaged in movement of grains interprovincially all indicated that the cost of fines and legal services were normally passed on to the grain producer in transportation charges. During 1971, there were strong demands for Saskatchewan grain in Alberta, and large quantities of grain for feed use were being transported. Other trade people felt that the existence of some enforcement tended to contain movement within reasonable bounds. Officials of the Board indicated that increases in the minimum levels of fines were necessary in order to enforce the legislation.

Interviews with truckers indicated a wide variety of volumes and destinations. Operations varied from individual farmers transporting grains over longer distances and supplying buyers in all parts of







Alberta. Movements varied from a few truckloads to several million bushels annually.

Producers generally, and particularly those in Western Saskatchewan, noted a lack of information available to them on prices offered on the non-Board market. There were instances reported of problems in dealing with truck agents. Normally truckers purchase grain from producers and resell grain to buyers in other areas. Unless binding contracts between the farmer and the trucker have been prepared, farmers are unwilling to take court action to enforce verbal contracts. In some cases producers have been given lower than agreed on prices and, because the movement is illegal, have felt they were in a poor position to enforce payment. Many producers felt that they were in a poor bargaining position because of poor information on feed grain prices and demands.

#### A Review of the Development of Spatial Analysis

This section traces the theoretical development of spatial analysis from the first works on equilibrium through the development of regional economics and space economy. The development of techniques for studying the interrelationships among market areas are then outlined.

#### Equilibrium among Markets

An early consideration of equilibrium was presented by Marshall in reference of general equilibrium [Marshall, 1922, Chapters 1, 2, and 3]. Other than to define a market, Marshall did not consider space in developing his system. Thus his theory of an industry equilibrium did not apply when spatial elements were considered.



The theory of exchange was extended by Hicks to describe a general equilibrium system based on consumer choice [Hicks, 1939, pp. 33-111]. This static system was then developed into a dynamic system by introducing several factors in addition to time.

Given a theory of space economy, Enke applied the theory of value to a knowledge of spatial elements in 1941 [Enke, 1941, pp. 627-637]. He proceeded to specify six "cases" or structural relations between producers and consumers on the basis of market structure and distribution of traders in space. Enke's analysis was based upon elasticity of supply or demand for each buyer and seller and upon the cases of monopolist or monopsonist in the marketplace. Enke concluded that spatial elements under general free market conditions were sufficient to:

1. Prevent the demand or supply schedule facing each producer or consumer from being infinitely elastic over the pertinent range;
2. Permit geographical price discrimination;
3. Exclude in practice all but one producer or consumer from the "market."

The Hicks' concept has since been further developed by Samuelson [Samuelson, 1961, pp. 259-275]. Like that of Hicks, Samuelson's description of equilibrium was based on consumer choice as a means for determining demand and supply. Samuelson gave definitions of comparative statics, stability, and dynamics. Comparative statics provided a benchmark for the discussion of dynamic equilibrium under various conditions. Samuelson's analysis of "stability of multiple markets" extended and



revised the Hicks' conditions for stability resulting in a more comprehensive analysis.

### Location Theory

Weber provided the first explicit treatment of locational factors in specific industrial activity [Weber, 1929]. Weber's analysis concerned the effects of labor and transportation costs on the location and thus the agglomeration of industries. Taking labor costs as constant, Weber identified the effects of transportation cost, based on distance and weight, on the orientation of a business between its material sources and markets. Weber proved that transportation cost is the most significant element affecting location by measurement of a "material index" (weight factor) and locational weight.

The contribution of Losch to location theory included three general considerations [Losch, 1954]. First, his analysis of location, unlike that of Weber, was concerned primarily with the demand side. Losch sought to depict market areas given assumptions about supply conditions. Thus, secondly, Losch described market areas by activity and attempted to determine optimum market areas on this basis. Thirdly, the shape of markets within large geographical areas was patterned for particular types of industries.

A comprehensive study of location and locational factors by Hoover published in 1948 [Hoover, 1948] provided an overall framework for a study of locational objectives and public policy. Such factors as plant size, plant costs, land use, and the labor market were considered in relation to transfer costs. Hoover also examined the effects



of political boundaries on location of industries. These boundaries take the form of restriction either on factor (labor, capital, and enterprise) or on commodity movements. Hoover stated:

Commodity movements, and factor movements, then, are somewhat substitutable for each other. . . a trade barrier is likely to increase the disparity of factor prices on the two sides of the border and to increase the incentives to migration of capital, enterprise and labour. If a reduction in this inequality be accepted as a criterion of overall efficiency or sound policy--as it quite generally is in domestic location--then it may be laid down as a general principle that a heightening of either sort of trade barrier (trade or factor) increases the need for a reduction of the other sort (Hoover, 1954, pp. 229-230].

An early attempt to define market areas was made by Fetter [Fetter, 1924]. This author attempted to describe the "extent and shape" of a market on the basis of market prices and freight rates. Fetter's use of transportation rates was restricted to defining areas within which competitive product prices could be maintained. A treatment of the shape of markets was provided which indicated the nature of market prices between two geographic points. Fetter concluded:

Size of market territories may be said to be a function of the differential of market base prices, freight rates remaining constant and vice versa; that is, the higher the market price in any market relative to that in its geographical competition the narrower the territory that is tributary to it [Fetter, 1924, p. 527].

Fetter applied this relationship to considerations of both buying and selling markets.

The case described by Fetter was typified by a county fair where traders meet and transfer goods at a central market. This situation was elaborated by Enke, who provided two general cases of





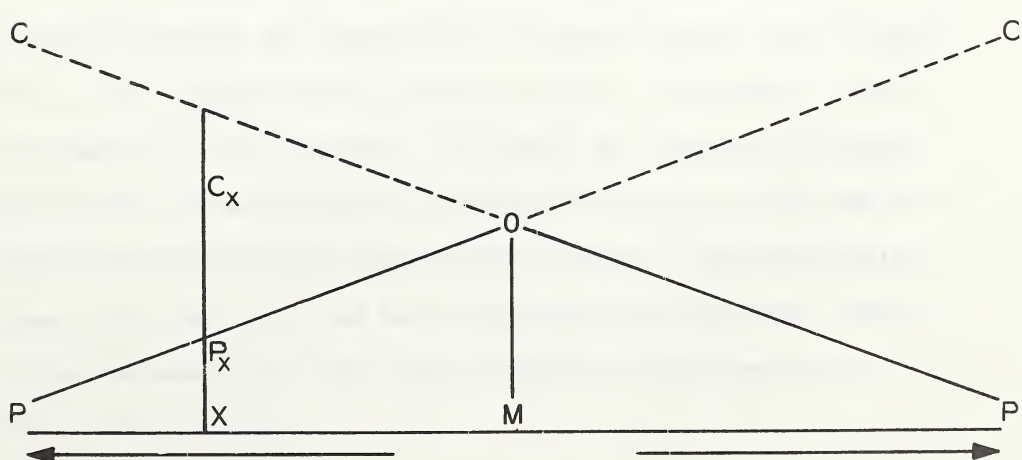


relevance to feed grains marketing, including variations of the types Fetter described [Enke, 1941]. Given a centrally located market with many producers and consumers represented, if all lots of commodity traded must pass through the market, the price elasticity of supply and demand will be infinite. However, because revenues and expenses of producers and consumers differ, this type of marketing system is not always efficient. If price competition exists between producers and consumers, there will be "a powerful incentive for P's (producers) and C's (consumers), especially if far removed from the market, to short-circuit it" [Enke, 1941, pp. 630-631]. Grains marketing through the Canadian Wheat Board, if all sales were placed through Board channels, would closely resemble this system. Enke stated:

With active price competition between many buyers and sellers, however, it is unlikely that all exchanged units of the product would continue to be distributed 'via M' (market) [Enke, 1941, p. 630].

Figure 1

TRADING AREA WITH A CENTRAL MARKET





The relative prices to producers and consumers are indicated in Figure 1.  $PP'$  and  $CC'$  indicate the transportation costs incurred by producers and consumers. At a distance  $MX$  from the market, producers will receive  $P_x$  and consumers will pay  $C_x$ . The difference is transportation cost. Enke stressed that only if all producers are at one end of a line and all consumers at the other with a central market can this system be approached.

The variation of this system with the specification that only some lots of commodity are traded at the market is included. Thus the market price will set limits for the commodity prices in the area. Between these limits (e.g.,  $P_x$  and  $C_x$ ), the prices at which the commodity is traded will be determined by demand and supply at each point in the area. Producers and consumers in close proximity will trade at prices that represent sharing of transportation charges. "Only as a last resort will P's (producers) ship to M (the market) or C's (consumers) take delivery there" [Enke, 1941, p. 632]. Prices may differ at each point of trading.

The second case Enke described is a less structured market in which producers and consumers are scattered randomly over a market area, a case exemplified by non-Board trade in feed grains. Price discrimination may be expected. Producers and consumers can expand their market areas by adjusting prices or by quoting prices some distance away and absorbing transportation charges. Buyers and sellers compete with each other and have independent price policies. Unless prices are negotiated, there are four means of price quotations [Enke, 1941, p. 633]:



Figure 2

DECENTRALIZED MARKET, SCHEDULE 1  
PRODUCER DETERMINED DELIVERED PRICES

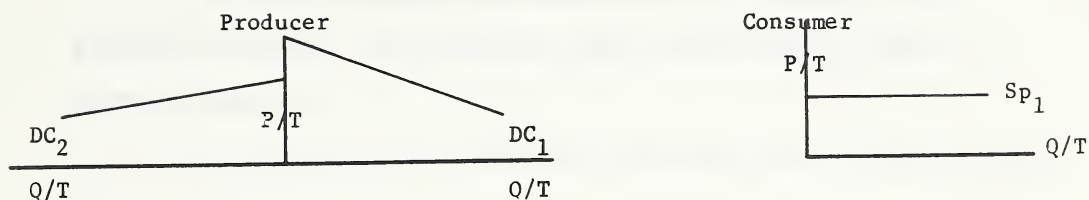


Figure 3

DECENTRALIZED MARKET, SCHEDULE 2  
CONSUMER DETERMINED F.O.B. PRICES

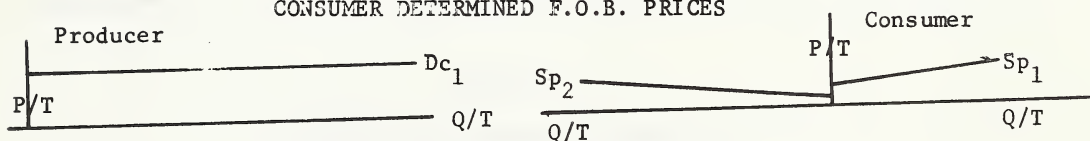
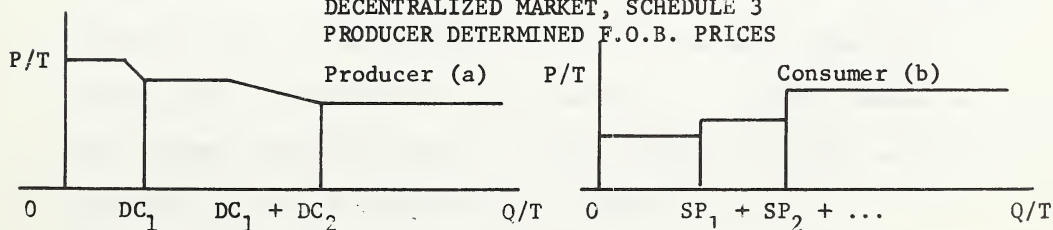


Figure 4

DECENTRALIZED MARKET, SCHEDULE 3  
PRODUCER DETERMINED F.O.B. PRICES





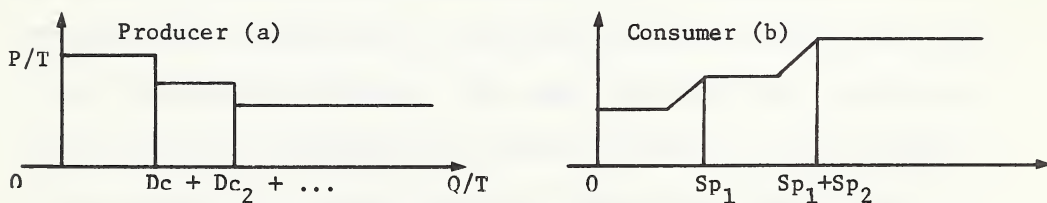
1. Producers determine delivered prices which are accepted by consumers. Each producer will have a demand curve for each consumer, as shown in Figure 2.

2. Each consumer determines his f.o.b. prices at each producer's location. The producers accept these prices. This is shown in Figure 3.

3. Each producer determines his prices and sells f.o.b. only. Consumers accept these prices of producers, as shown in Figure 4. Consumers purchase from each producer (a) only as the producer lowers his price. As the price is lowered, some consumer suddenly switches his purchase to the individual producer. A large consumer (b) will have to pay increasing higher prices to maintain supplies from various producers.

Figure 5

DECENTRALIZED MARKET, SCHEDULE 4  
CONSUMER DETERMINED DELIVERED PRICES



4. Consumers determine their prices and buy delivered only. Producers accept the prices quoted by consumers, as shown in Figure 5. Producers sell to the consumer (b) only as consumers raise their prices; that is, they switch sales suddenly to a given consumer as the consumer quotes his price. A large producer (a) will sell his commodity in lots as consumer prices dictate.

The above cases provide a useful framework for the analysis of feed grain prices.





### Development of the Transportation Model

A mathematical explanation of the solution of the transportation problem was first provided by Hitchcock [Hitchcock, 1941]. Using the case of several factories supplying consumer goods to several cities, a technique for determining the most efficient allocation of production was explained. Given the set of production and consumption relations, a set of equations was formulated with one equation omitted and the remaining equations expressed in terms of the omitted equation. Substitution resulted in the expression of total transfer cost in terms of the equations exclusive of the omitted relation. The system was then solved for a minimum value of transportation cost. The constraints expressed on the transportation problem are implicit in the above system of equations. Solution of the system providing optimal flows of commodity was not necessarily unique.

A nonmathematical presentation of the transportation model was prepared by Koopmans in 1949 [Koopmans, 1949]. This description was an application of the theory of optimum allocation of resources to the ocean transportation industry. The same constraints and functions as those presented in mathematical forms were implicit in the treatment of the problem as a system of prices. Marginal costs may be used to determine optimum allocation of transportation equipment. Koopmans distinguished direct and indirect components of transportation costs. Direct costs were incurred in the time spent in empty movements of transportation equipment. The objective was to minimize marginal costs in all movements by a system of trial and error. This system had several shortcomings, particularly because of its rigidity.



Koopmans described a "Model of Transportation" for ocean shipping given the cases of 1) a model with two ports, and 2) a model with "n" ports [Koopmans, 1951, pp. 222-259]. For each case, he specified a matrix of activities, defined the commodity space within which the solution existed, and provided the solution technique. The model was completed with an extension to "efficiency prices" and capacity restrictions. The example provided by Koopmans was that of international ocean cargo shipping. Efficiency pricing based on marginal costs was applied to a central shipping authority and to market pricing in a competitive shipping industry. Koopmans' description was more comprehensive than that of Hitchcock, but was largely an extension of Hitchcock's earlier work.

The problem of establishing equilibrium among markets was stated by Enke as follows:

There are three (or more) regions trading a homogenous good. Each region constitutes a single and distinct market. The regions of each possible pair of regions are separated--but not isolated--by a transportation cost per physical unit which is independent of volume. There are no legal restrictions to limit the actions of the profit seeking traders in each region. For each region, the functions which relate local production and local use to local price are known and, consequently, the magnitude of the difference which will be exported or imported at each local price is also known. Given these trade functions and transportation costs we wish to ascertain:

1. the net price in each region;
2. the quantity of exports or imports for each region;
3. which regions import, export, or do neither;
4. the aggregate trade in each commodity;
5. the volume and direction of trade between each possible pair of regions. . . [Enke, 1951, p. 41].



### Summary

Economists have been developing a theory of space economy and location over a long period of time. General equilibrium as treated by Hicks [1939] and later by Samuelson [1961] described an economy in which producers and consumers were located at one point. The works of Weber [1929], Hoover [1948], Losch [1954], and others provided for inclusion of a spatial array of economic activities. Koopmans [1951] and others then developed activity analysis models.

The transportation model was originated by F.L. Hitchcock before linear programming was used [Dorfman, 1958, p. 106]. With the development of computing techniques, linear programming formats have been applied to the transportation problem. This resulted in development of the capacity to measure interregional competition.

Several empirical studies of interregional competition and commodity movement using the transportation model have been conducted. Henry and Bishop [1957] and later Snodgrass and French [1958] provided analyses of the broiler and dairy industries respectively to determine optimal allocation and distribution of production. Dennis and Sammet [1961] performed an extensive analysis of the frozen strawberry industry to determine optimal use of production resources and processing facilities. More recently Craddock [1970] provided optimum patterns for Western Canadian grains production; calculated production costs which provide the most efficient production patterns are derived. Because of its versatility, the transportation model may be applied to many and varied empirical problems.



## CHAPTER IV

### PRESENTATION OF THE ECONOMIC MODEL

The purpose of this chapter is to outline the procedures, techniques, data sources, and rationale used for the quantitative analysis in this study. The techniques for determining regional demands and supplies and a description of spatial organization are presented in detail. A second section deals with the transportation model. The form of the model with a description of its nature and limitations is included. The actual solution technique is implicit within the description. The final section provides a short format for analysis of actual prices and determined regional prices.

#### Spatial Organization

The total market area for which the analysis was conducted included the provinces of Manitoba, Saskatchewan, and Alberta exclusive of the area of Alberta included in Census Division Fifteen. This area coincided with the Designated Area as defined in the Canadian Wheat Board Act with the Peace River areas of British Columbia and Alberta excluded. The market area was delineated into eighteen regions selected on the basis of the following criteria:

1. The availability of data and disaggregation of this data;
2. The homogeneity of conditions within regions;
3. A general consistency in size of regions.

Alberta was divided into six discrete units corresponding to Agricultural Reporting Areas One through Six inclusive. Although







there is a wide variation in livestock numbers, poultry numbers, and feed grain production among these regions, production patterns within each region are generally consistent. Although there is a wide variation in regions one, three, and six, most of the feeding operations are centered about a small area within each of these three regions. Saskatchewan is delineated into nine regions corresponding to the crop districts. Data availability and consistency in area and production patterns indicate that this is an acceptable spatial pattern. On the basis of geographical features and production patterns, Manitoba is divided into three regions. Region seventeen is isolated and consistent within itself. The remaining agricultural area is divided in two sections, regions sixteen and eighteen, based on livestock production patterns. Further delineation would result in similar units associated closely enough geographically to result in the increased possibility of crosshaulage, which cannot be shown in the analysis.

In each of the eighteen regions, a central locus was chosen to establish point demands and supplies. The points chosen were selected so that each coincided with a major incorporated area and each was served by major north-south and east-west highways having at least a 72,000 pound load limit. Transportation costs between all pairs of regions were based on truck transportation costs between the central points in the regions. Figure 6 illustrates the various regions and their nodes. Truck transportation rates were provided from published sources based upon competitive rate structures and upon regulated rates [Western Transportation Association Tariff #345]. These rates are shown in Appendix A.



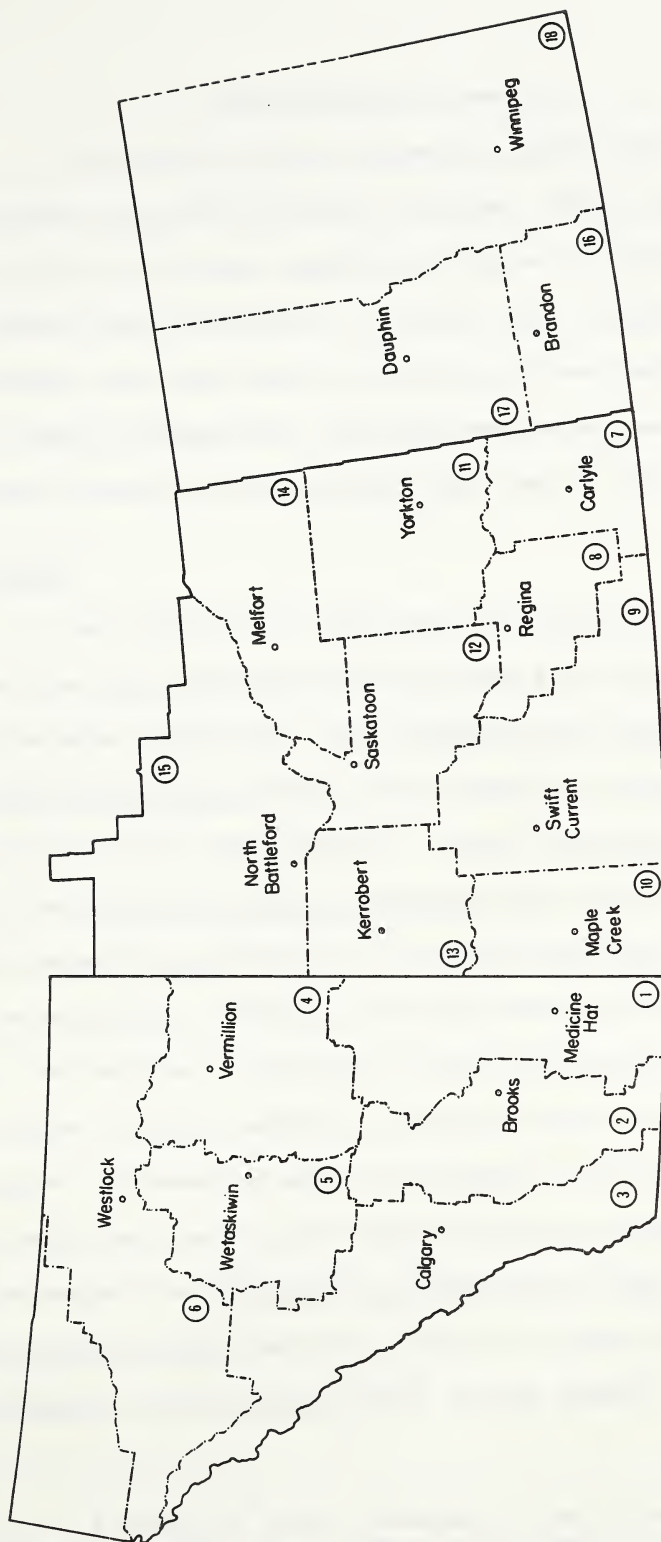


Figure 6  
REGIONAL DEMARCATION OF STUDY AREA



### Specification of Demands

This section outlines the means whereby demands for grains as livestock and poultry feed were itemized. These techniques were used in all of the models specified in Chapter V. All grain consumption for feed use was determined on a crop year basis (August 1 to July 31). Consumption rates were based on marketings of meat, milk, and eggs and on actual feeding rates. In cases where actual and optimal feeding practices differed, the actual rates were used in this study.

#### Beef Cattle

Two categories of cattle were delineated from the marketings: feeders that were fattened before marketing and cattle that were not grain fed when slaughtered. This information was derived from the Livestock Market Review [CDA, various issues] and concurred with research done by Love [Love, 1969, Table 9]. Actual livestock marketings were taken from Origin of Livestock Marketed reports [CDA, various issues]. Monthly sales were aggregated on a crop year basis and delineated into the two categories according to the corresponding annual data. Monthly sales are presented on the basis of the crop district of origin. Given the origins of cattle marketed, a volume of grain in bushels of barley equivalent<sup>1</sup> consumed per head was allocated to the respective regions. This coefficient, set at 54.6 bushels of barley equivalent per head, was determined from Feed Grains of Canada [CGC, 1970], Nutrient Requirements for Beef Cattle [National Academy of Sciences, 1966], and Alberta Farm Business Analysis Reports [ADA, various issues]. The coefficient

---

<sup>1</sup>A bushel of barley equivalent is the volume of any grain equivalent in feeding value to that of one bushel of feed barley.



for consumption of barley equivalents for breeding cows was derived from Alberta Cow-Calf Enterprise Analysis Reports [ADA, 1967]. Thus annual requirements were specified on a per beef cow basis. Consumption rates for cows and bulls were set at 5 and 7-1/2 bushels of barley equivalent respectively. This was based on an animal unit index. Numbers of cows and bulls on farms were obtained from Statistics of Agriculture for Alberta [ADA, various issues], data compiled by Bray [Bray, 1971], and the Yearbook of Manitoba Agriculture [MDA, various issues].

### Dairy Cattle

Consumption of grain by dairy cattle was based upon levels of production. This information was obtained for Alberta and Saskatchewan from Hughes [Hughes, 1970] and from the Dairy Farm Business Summary [Porter, 1970]. Production levels for Manitoba dairy herds were determined from the Yearbook of Manitoba Agriculture [MDA, various issues]. Numbers of dairy cows by region were derived from Statistics of Agriculture for Alberta [ADA, various issues], data compiled by Bray [Bray, 1971], and the Yearbook of Manitoba Agriculture [MDA, various issues]. Given production levels and cattle numbers, grain consumption per dairy cow was then determined from Feed Grains of Canada [CGC, 1970] and other publications [Combs *et al.*, 1970]. The coefficients of grain consumption per dairy cow were set at 29.17 bushels of barley equivalent for Manitoba herds.

### Hogs

Consumption by hogs was set at fourteen bushels of barley





equivalent per hog marketed. This was based on Feed Grains of Canada data [CGC, 1970]. Marketings of hogs were derived from Origin of Livestock Marketed reports [CDA, various issues] on the basis of specified regions.

### Poultry

Consumption of grain by turkeys was derived from cost comparison studies by the Alberta Department of Agriculture and from information provided by Johnson [Johnson, 1971] on poultry feeding practices. Consumption rates were separated into categories over and under sixteen pounds at marketing. For the heavy category, sixty-nine pounds of barley equivalent was assigned; the light category was assigned eighteen and one-half pounds of barley equivalent per bird on a feed conversion basis. Marketings of turkeys was taken from the Poultry Market Review [CDA, various issues]. Given marketings, the regional distribution of turkey production was derived from census data [DBS, 1968] for Alberta and Manitoba and from the Annual Reports of the Saskatchewan Department of Agriculture [SDA, various issues].

Consumption of grain by broilers and roasters was determined to be 3.75 pounds of barley equivalent per broiler and 9.0 pounds per roaster [Johnson, 1971]. The distribution of Alberta and Manitoba broiler and roaster production was derived from quota allotments provided by the Alberta Broiler Producers Marketing Board and the Manitoba Chicken Broiler Producers Marketing Board. Location of broiler production in Saskatchewan was provided by Bray [Bray, 1971]. Marketings of broilers and roasters were derived from the Poultry Market Review [CDA, various issues].



Grain consumption for the production of eggs is directly related to the productivity of the flock. The rate of feeding used in this study was five pounds of grain per dozen eggs [Johnson, 1971]. Thus given egg production, grain consumption can be calculated. Regional distribution of egg production was taken from the Yearbook of Manitoba Agriculture [MDA, various issues], data collected by Bray [Bray, 1971], and Statistics of Agriculture for Alberta [ADA, various issues] on the basis of numbers of laying hens and chickens on farms. No consumption of grain was assigned to fowl, for this category of chicken is normally marketed when egg production declines.

#### Adjustments to Regional Demands

Disposition of grain for animal feed cannot be known exactly. The Dominion Bureau of Statistics [DBS, various issues] publishes data on grains fed to livestock and poultry. This data is a residual figure determined after all other uses of grain have been estimated. Inventory figures are adjusted periodically to coincide with actual supplies as they become visible. Feed, waste, and dockage are adjusted accordingly. Similarly, adjustment of the regional demands in a feed grain transportation model to coincide with calculated total demand is necessary in order to improve the accuracy of the model. Because they are consistent on a long run basis, DBS data give the most reliable estimates available. The model was adjusted to be consistent with these totals.

#### Regional Supply

Grains available for livestock and poultry consumption were determined by the following method. Gross production of wheat, oats,



barley, and mixed grains was determined for each of the eighteen regions from data collected by the Alberta, Saskatchewan, and Manitoba Departments of Agriculture. Net receipts of the grains at elevators published by the Dominion Bureau of Statistics [DBS, various issues] were derived from research done by Craddock [Craddock, 1970, pp. 123-124]. Seed use was calculated from the acreage seeded to each respective grain in the crop year following the time period being analyzed.

Feeding value of the various grains was established from the bushel weights as specified by the Dominion Bureau of Statistics [DBS, various years] and from nutrient content as described in Feed Grains of Canada [CGC, 1970]. Mixed grains was taken to be composed of equal parts of oats and barley [Craddock, 1970]. The feeding value coefficients were set at 1.27, 1.00, 0.73, and 0.86 respectively for wheat, barley, oats, and mixed grains.

### Transportation Problem

#### Description

The transportation model is an economic tool readily adaptable to the study of commodity movements. To study interregional feed grain movement, the model is formulated in terms of point demands and point supplies both of fixed quantities and or originating regions and destinations. In this case feed grain, an intermediate product for the production of meat, milk, and eggs, is allocated on a regional basis to match demands. In order to study the efficiency of the prairie feed grain economy, the mobility of the products must be specified. The problem was to ascertain:



1. The relative price levels of feed grain within the market area,
2. The quantity of feed grains imported and exported from each region such that demands are met within the specified constraints,
3. The net trade and the total transport cost of movement of feed grains within the market area,
4. The volume and direction of trade within the market area such that net returns to producers in each region are maximized and that transport cost is minimized.

#### Assumptions

Several simplifying and explanatory assumptions were necessary to describe the terms of reference of this model. These assumptions and conditions depict the nature of the prairie markets for feed grain as described by the model formulation.

1. Regional prices and interregional flows are consistent with the conditions of perfect competition.
2. Each producer is assumed to maximize profits.
3. The supply of feed grain and the demand for feed grain in each region can be represented at a single point within that region.
4. Supplies and demands for each region may be taken as given for a single crop year.
5. All regions are connected by transportation costs which are independent of the volume or direction of trade between regions and which can be represented by a continuous linear function.
6. Flows of feed grains among regions are not constrained by government or other interference.







7. All feed grains are homogenous and consumers are indifferent to sources of supplies.

8. Factors affecting regional consumption are given predetermined values.

9. There are no exports from or imports to the total market area of feed grains.

10. Feed grains produced within a region may be consumed within that region.

11. There are no negative shipments and no crosshauling of feed grains.

### The Mathematical Model

#### Specification of the Functional Form

Given the objectives and assumptions of the feed grain transportation model, the problem may be formulated as follows. Minimize:

$$T = \sum_{i=1}^m \sum_{j=1}^n C_{ij} X_{ij}, \quad (1)$$

where  $T$  = total transportation cost for shipment between all pairs of regions;  $m = 1, 2, \dots, 18$ ;  $n = 1, 2, \dots, 18$ ;  $C_{ij}$  = tariff per bushel of barley equivalent from origin  $i$  to destination  $j$ ;  $X_{ij}$  = volume of feed grain in bushels of barley equivalent moved from origin  $i$  to destination  $j$  [Walker, 1964, p. 1]. Total cost of transportation ( $T$ ) is minimized subject to:

$$\sum_{i=1}^m X_{ij} \geq D_j, \quad (2)$$

where  $D_j$  is the number of bushels of feed grain required or deficit in destination region  $j$ , and:



$$\sum_{j=1}^n X_{ij} \leq S_i, \quad (3)$$

where  $S_i$  is the number of bushels of feed grain to be exported or of surplus in originating region  $i$ . In order to facilitate programming, this relation may be expressed as:

$$-\sum_{j=1}^n X_{ij} \geq -S_i. \quad (3')$$

The above relations form the primal transportation model. The dual problem is stated as follows [Dorfman, Samuelson and Solow, 1958, pp. 123-124]:

$$S = \sum_{j=1}^n D_j V_j - \sum_{i=1}^m S_i U_i, \quad (4)$$

subject to:

$$V_j - U_i \leq C_{ij} \text{ and } U_i, V_j \geq 0, \quad (5)$$

where  $V_j$  is the value for feed grain at destination region  $j$  and  $U_i$  is the value of feed grain in originating region  $i$ . This cannot differ by more than the tariff for movement of grain between these regions. Total value of transported feed grains at destinations less the value of this grain at the origins is to be maximized. For origin-destination pairs that trade, the difference in value is equal to transportation cost, and the pairs are included in the optimal solution. Origin-destination pairs for which this relation does not hold in the solution have a value for feed grain at destinations that is less than the value at origins plus the transportation cost or values that are equal, though no physical movement of feed grain is specified. Thus the optimal



solution need not be unique.<sup>1</sup> In this case the transfer route could be included in an alternative shipping plan [Dorfman, Samuelson and Solow, 1958, p. 124]. The value  $V_j$  of feed grains at destinations in the optimal solution is a "shadow price" for the product. The transportation cost or tariff for these movements may be referred to as value added. Thus the solution of the dual provides value differences between regions and the maximum total value added, but does not yield actual or real prices.

#### Solution of the Mathematical Model

The computer program used in the analysis was provided by the University of Alberta, Department of Computing Science. The transportation model is solved using the UV algorithm. The initial suboptimal solution is obtained through use of the northwest corner rule.

#### Weaknesses of the Model

Several weaknesses are inherent in the analytical format presented above:

1. The regions defined in the analysis may not exactly coincide with the actual markets in the market area. Large feedlots may tend to influence the shape of local markets if they are not situated at natural foci of trade in grains. Highways also influence the shape of trading areas. This influence cannot always be reconciled with the limitations resulting from data aggregation.

---

<sup>1</sup>Nonoptimal cost coefficients may be included in the optimal solution because certain nonoptimal shipments may increase total transfer cost only slightly [Walker, 1964, p. 6].



2. There is some error in the simulation of feeding practices in that not all livestock and poultry producers feed identical rations. Many feeding practices indicate that not all producers maximize profits. For this reason generally accepted feeding levels must be adjusted to coincide with actual aggregate disappearance in the market area.

3. The assumptions implicit in the application of a transportation model may lead to certain imperfections in the analysis. The first assumption cited, that indicating conditions of perfect competition, may be criticized. Prairie feed grain markets are characterized by a significant lack of information on grain prices and grain price differentials among regions. This feature results in variations in the prices at which grain is traded in excess of transportation cost differentials within regions. The third assumption provides a definition or description of the market for feed grains in each individual trading area or region. Although not all grains are traded through central markets, local prices are often determined largely by local conditions, which are reflected in the prices of large local consumers. Interregional movements tend to affect all feed grain trading prices within both the originating and destinating regions. Analysis of truck transportation rates indicates that for movement of grains across distances of less than one hundred miles, the rates may not approximate continuous linear functions. This, however, does not seriously hamper the analysis.

4. Solution of the model will indicate minimum levels for movement of grain. Under conditions of extreme surplus in some regions, price of grains sold on the non-Board market may be lowered significantly





and yet retain constant per acre return for feed grain producers.

In this case grain may move into self-sufficient areas and trade at competitive prices. Thus actual movements may exceed the minimal levels indicated by the analysis.



## CHAPTER V

### ANALYSIS OF FEED GRAIN MOVEMENTS

This chapter defines the Prairie non-Board feed grains market in terms of volumes and prices of feed grains. The allocation of existing supplies to specified demands is carried out for all regions. A discussion of the analysis is provided outlining the major findings and implications of the results. Weaknesses of the analysis are then presented.

#### Specific Model Formulations

The analysis consists of four models, each of which was applied to the three crop years 1967-68, 1968-69, and 1969-70. These models provide various aggregations of demands and supplies for the market and indicate interregional movements under various assumptions. For all models inventory was adjusted from year to year. In all cases for which a deficit occurred, inventory accumulated for the particular model in previous years was added to supplies in the deficit year. Intertemporal inventory flows are shown in Appendix B. Only in the 1969-70 crop year was inventory from previous years entered into supplies. Adjustments were made for all models.

Supply and disposition tables include negative entries. Negative supply entries indicate that supplies were not sufficient to meet quota deliveries and that movements to fill quota occurred in volumes equivalent to the negative entries.



### Model I

The aggregation presented in Model I provides the allocation of grains to total specified regional demands on the basis of complete indifference on the part of buyers and sellers. Demands for feed grains specified for all types of livestock and poultry are aggregated and then adjusted to match total disappearance of grains in the total market area on a regional basis. Supply and disposition under the conditions of Model I for the three crop years considered are shown in Table 2.

### Results of Model I

Model I, 1967-69--The availabilities and requirements of feed grains for 1967-68 under the conditions of Model I with the equilibrium interregional movements are shown in Table 3. The solution indicates movement between ten pairs of regions. Total interprovincial movement consisted of 2,891,000 bushels originating at Kerrobert, Saskatchewan (region 13) and moved to Medicine Hat, Alberta (region 1). Restricted movement did not appreciably increase transportation costs for movements within Alberta were rerouted to match the specified demands. Total movement into inventory (region nineteen) was 64,100,000 bushels. For the solution of this model the program did not present one unique solution. As a result, the second best, or last suboptimal, solution was taken for both the restricted and unrestricted movement programs.

Model I, 1968-69--Table 4 shows the supply and disposition for 1968-69 and the movement of grain. Under the conditions of Model I, movement occurred between only three pairs of regions, and none of this



movement was across provincial boundaries. Movement into inventory was 248,004,000 bushels. All regions excepting three, six, and eight produced sufficient volumes of grain to be in a surplus position.

Model I, 1969-70--Table 5 gives the supply, disposition, and movement data for 1969-70. In this case movement occurred between three pairs of regions. The previous years' inventory from the results of the Model I, 1968-69, was forwarded; the volumes were to region three, 8,548,000 bushels, to region sixteen, 11,593,000 bushels, and to region eighteen, 12,761,000 bushels. Movement into inventory from the solution of Model I, 1969-70, was 258,100,000 bushels.





Table 2

SUPPLY AND DISPOSITION: MODEL I

(Bushels of Barley Equivalent x 1000)

Region	1967-68		1968-69		1969-70	
	Supply	Demand	Supply	Demand	Supply	Demand
1	4,085	8,024	15,182	8,689	15,523	10,271
2	33,704	26,560	61,264	35,790	53,023	38,954
3	21,611	27,994	43,486	18,721	43,145	39,185
4	47,698	30,198	37,505	30,281	57,283	38,326
5	41,780	41,493	38,222	41,141	44,808	51,091
6	17,751	22,216	22,473	22,865	29,001	26,678
7	10,911	7,424	12,874	7,160	36,638	8,624
8	5,464	8,938	7,912	8,467	36,889	7,752
9	- 596	10,580	16,731	9,383	58,574	10,331
10	- 918	2,893	7,827	3,247	5,162	3,396
11	14,182	10,925	37,591	11,143	51,999	14,149
12	15,472	8,338	42,968	8,881	48,233	11,935
13	20,467	3,774	21,448	3,658	24,186	5,418
14	15,256	9,464	37,010	9,214	19,381	13,245
15	30,559	14,275	25,589	15,596	27,903	19,370
16	33,816	22,733	56,243	23,847	48,279	33,601
17	14,004	7,617	16,309	7,308	15,278	10,201
18	34,440	32,140	45,481	32,720	29,392	44,070
19		64,100		248,004		258,100



Table 3

## REGIONAL ALLOCATION: MODEL I, 1967-68

(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	4,085	1	1	4,085
2	1	1,048	2	1	3,393
2	2	26,560	2	2	26,560
2	3	6,096	2	3	3,205
3	3	21,611	3	3	21,611
4	4	30,198	4	3	2,891
4	6	4,465	4	4	30,198
4	19	13,035	4	6	4,465
5	3	287	4	19	10,144
5	5	41,493	5	3	287
6	6	17,751	5	5	41,493
7	7	7,424	6	6	17,751
7	8	217	7	7	7,424
7	19	3,270	7	8	217
8	8	5,464	7	19	3,270
11	8	3,257	8	8	5,464
11	11	10,925	11	8	3,257
12	9	3,323	11	11	10,925
12	10	3,811	12	9	7,134
12	12	8,338	12	12	8,338
13	1	2,891	13	13	3,774
13	13	3,774	13	19	16,693
13	19	13,802	14	14	9,464
14	14	9,464	14	19	5,792
14	19	5,792	15	9	4,042
15	9	7,853	15	10	3,811
15	15	14,275	15	15	14,275
15	19	8,431	15	19	8,431
16	16	22,733	16	16	22,733
16	19	11,083	16	19	11,083
17	17	7,617	17	17	7,617
17	19	6,387	17	19	6,387
18	18	32,140	18	18	32,140
18	19	2,300	18	19	2,300



Table 4

## REGIONAL ALLOCATION: MODEL I, 1968-69

(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	8,689	1	1	8,689
1	19	6,493	1	19	6,493
2	2	35,790	3	3	35,790
2	19	25,474	2	19	25,474
3	3	18,721	3	3	18,721
3	5	2,919	3	5	2,919
3	19	21,846	3	19	21,846
4	4	30,281	4	4	30,281
4	6	392	4	6	392
4	19	6,832	4	19	6,832
5	5	38,222	5	5	38,222
6	6	22,473	6	6	22,473
7	7	7,160	7	7	7,160
7	19	5,714	7	19	5,714
8	8	7,912	8	8	7,912
9	9	9,383	9	9	9,383
9	19	7,348	9	19	7,348
10	10	3,247	10	10	3,247
10	19	4,580	10	19	4,580
11	8	555	11	8	555
11	11	11,143	11	11	11,143
11	19	25,893	11	19	25,893
12	12	8,881	12	12	8,881
12	19	34,087	12	19	34,087
13	13	3,658	13	13	3,658
13	19	17,790	13	19	17,790
14	14	9,214	14	14	9,214
14	19	27,796	14	19	27,796
15	15	15,596	15	15	15,596
15	19	9,993	15	19	9,993
16	16	23,847	16	16	23,847
16	19	32,396	16	19	32,396
17	17	7,308	17	17	7,308
17	19	9,001	17	19	9,001
18	18	32,720	18	18	32,720
18	19	12,761	18	19	12,761



Table 5

## REGIONAL ALLOCATION: MODEL I, 1969-70

(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	10,271	1	1	10,271
1	19	5,252	1	19	5,252
2	2	38,954	2	2	38,954
2	19	14,069	2	19	14,069
3	3	39,185	3	3	39,185
3	5	3,960	3	5	3,960
3	19	13,298	3	19	13,298
4	4	38,326	3	4	38,326
4	19	18,957	4	19	18,957
5	5	44,808	5	5	44,808
6	5	2,323	6	5	2,323
6	6	26,678	6	6	26,678
7	7	8,624	7	7	8,624
7	19	28,014	7	19	28,014
8	8	7,752	8	8	7,752
8	19	29,137	8	19	29,137
9	9	10,331	9	9	10,331
9	19	48,243	9	19	48,243
10	10	3,396	10	10	3,396
10	19	1,766	10	19	1,766
11	11	14,149	11	11	14,149
11	19	37,850	11	19	37,850
12	12	11,935	12	12	11,935
12	19	36,298	12	19	36,298
13	13	5,418	13	13	5,418
13	19	18,768	13	19	18,768
14	14	13,245	14	14	13,245
14	19	6,136	14	19	6,136
15	15	19,370	15	14	19,370
15	19	8,533	15	19	8,533
16	16	33,601	16	16	33,601
16	18	14,678	16	18	14,678
16	19	20,803	16	19	20,803
17	17	10,201	17	17	10,201
17	19	5,077	17	19	5,077
18	18	29,392	18	18	29,392





## Model II

An alternative aggregate model was presented based upon allocation of wheat to poultry consumption and of coarse grains to livestock consumption. Demands by region were adjusted such that the total demand coincided with the published data, then aggregated to yield total demands directly. These demands were then matched to total supplies of all grains. Supply and disposition data for Model II are shown in Table 6.

## Results of Model II

Model II, 1967-68--Movement of grains between eleven pairs of regions is indicated from the solution of this system shown in Table 7. As was the case in Model I, 1967-68; Model II, 1967-68, indicates movement from region thirteen to region one. Total transportation cost was not increased significantly by the restriction because supplies could be allocated from regions two and four. Inventory accumulation was 64,100,000 bushels. For this model the second best, or last suboptimal, solution was chosen.

Model II, 1968-69--Interregional movements under the conditions of Model II are shown in Table 8. Regions five and eight were the only two deficit areas and were partially supplied from regions three and eleven respectively. All other regions were self-sufficient in feed grains.

Model II, 1969-70--Table 9 shows the solution data for this model. The following inventory adjustments were made. Inventory from Model II, 1968-69, included 5,551,000 bushels in region three,



45,000 bushels in region six, 23,458,000 bushels in region sixteen, and 9,523,000 bushels in region eighteen. Total inventory flow for this model was 267,620,000 bushels. Regions five and eighteen were deficit. Region five was supplied jointly by regions three and six, and region eighteen was supplied from region sixteen.



Table 6

SUPPLY AND DISPOSITION: MODEL II

(Bushels of Barley Equivalent x 1000)

Region	1967-68		1968-69		1969-70	
	Supply	Demand	Supply	Demand	Supply	Demand
1	4,085	7,651	15,182	8,434	15,523	9,685
2	33,704	26,156	61,264	35,109	53,023	37,778
3	21,611	27,216	43,486	18,682	51,181	37,676
4	47,698	29,307	37,505	29,470	57,283	36,917
5	41,780	41,012	38,222	40,891	44,808	50,584
6	17,751	21,545	22,473	22,428	29,046	25,742
7	10,911	7,107	12,874	6,982	36,638	8,217
8	5,464	8,627	7,912	8,302	36,889	7,610
9	- 596	10,616	16,731	9,250	58,574	10,142
10	- 918	2,810	7,827	3,183	5,162	3,300
11	14,182	11,132	37,591	11,276	51,999	14,453
12	15,472	8,280	42,968	8,830	48,233	11,745
13	20,467	3,755	21,448	3,658	24,186	5,350
14	15,256	9,201	37,010	9,072	19,381	12,749
15	30,559	13,633	25,589	15,146	27,903	18,249
16	33,816	22,805	56,243	23,882	60,144	33,532
17	14,004	7,550	16,309	7,288	15,278	10,102
18	34,440	37,183	45,481	35,958	26,154	52,766
19		64,100		248,004		267,620



Table 7

## REGIONAL ALLOCATION: MODEL II, 1967-68

(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	4,085	1	1	4,085
2	1	2,711	2	1	3,566
2	2	26,156	2	2	26,156
2	3	4,837	2	3	3,982
3	3	21,611	3	3	21,611
4	4	29,307	4	3	855
4	6	3,794	4	4	29,307
4	19	14,597	4	6	3,794
5	3	768	4	19	13,742
5	5	41,012	5	3	768
6	6	17,751	5	5	41,012
7	7	7,107	6	6	17,751
7	8	113	7	7	7,107
8	8	5,464	7	8	133
11	8	3,050	7	19	5,464
11	11	11,132	11	8	3,050
12	9	3,464	11	11	11,132
12	10	3,728	12	9	3,464
12	12	8,280	12	10	3,728
13	1	855	12	12	8,280
13	13	3,755	13	13	3,755
13	19	15,857	13	19	15,197
14	14	9,201	14	14	9,201
14	19	6,055	14	19	6,055
15	9	7,748	15	9	7,748
15	15	13,633	15	15	13,633
15	19	9,178	15	19	9,178
16	16	22,805	16	16	22,805
16	18	2,743	16	18	2,743
16	19	8,268	16	19	8,268
17	17	7,550	17	17	7,550
17	19	6,454	17	19	6,454
18	18	34,440	18	18	34,440





Table 8

## REGIONAL ALLOCATION: MODEL II, 1968-69

(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	8,343	1	1	8,343
1	19	6,839	1	19	6,839
2	2	35,109	2	2	35,109
2	19	26,155	2	19	26,155
3	3	18,682	3	3	18,682
3	3	2,669	3	5	2,669
3	19	22,135	3	19	22,135
4	4	29,740	4	4	29,740
4	19	7,765	4	19	7,765
5	5	38,222	5	5	38,222
6	6	22,428	6	6	22,428
6	19	45	6	19	45
7	7	6,982	7	7	6,982
7	19	5,892	7	19	5,892
8	8	7,912	8	8	7,912
9	9	9,250	9	9	9,250
9	19	7,481	9	19	7,481
10	10	3,183	10	10	3,183
10	19	4,644	10	19	4,644
10	8	390	11	8	390
11	11	11,276	11	11	11,276
11	19	25,925	11	19	25,925
12	12	8,830	12	12	8,830
12	19	34,138	12	19	34,136
13	13	3,658	13	13	3,658
13	19	17,790	13	19	17,790
14	14	9,072	14	14	9,072
14	19	27,938	14	19	27,938
15	15	15,146	15	15	15,146
15	19	10,443	15	19	10,443
16	16	23,882	16	16	23,882
16	19	32,361	16	19	32,361
17	17	7,288	17	17	7,288
17	19	9,021	17	19	9,021
18	18	35,958	18	18	35,958
18	19	9,523	18	19	9,523



Table 9

## REGIONAL ALLOCATION: MODEL II, 1969-70

(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	9,685	1	1	9,685
1	19	5,838	1	19	5,838
2	2	37,778	2	2	37,778
2	19	15,245	2	19	15,245
3	3	37,676	3	3	37,676
3	5	2,472	3	5	2,472
3	19	16,584	3	19	16,584
4	4	36,917	4	4	36,917
4	19	20,366	4	19	20,366
5	5	44,808	5	4	44,808
6	5	3,304	6	5	3,304
6	6	25,742	6	6	25,742
7	7	8,217	7	7	8,217
7	19	28,421	7	19	28,421
8	8	7,610	8	8	7,610
8	19	29,279	8	19	29,279
9	9	10,142	9	9	10,142
9	19	48,432	9	19	48,432
10	10	3,300	10	10	3,300
10	19	1,862	10	19	1,862
11	11	14,453	11	11	14,453
11	19	37,546	11	19	37,546
12	12	11,745	12	12	11,745
12	19	36,488	12	19	36,488
13	13	5,350	13	13	5,350
13	19	18,836	13	19	18,836
14	14	12,749	14	14	12,749
14	19	6,632	14	19	6,632
15	15	18,249	15	15	18,249
15	19	9,654	15	19	9,654
16	16	33,532	16	16	33,532
16	18	26,612	16	18	26,612
16	19	8,903	16	19	8,903
17	17	10,102	17	17	10,102
17	19	5,176	17	19	5,176
18	18	26,154	18	18	26,154



### Model III

Model III deals only with coarse grains. Allocation of barley, oats, and mixed grains to all livestock feed grains demand is provided. Supply and disposition data are shown in Table 10.

### Results of Model III

Model III, 1967-68--Under the conditions of Model III, during the 1967-68 crop year movement occurred between fourteen pairs of regions. Four of these movements were interprovincial. Under restricted movement, the transportation costs resulting from changing distribution patterns increased by \$179,130. The patterns of movement are shown in Table 11. Inventory accumulation of 16,341,000 bushels of coarse grains was indicated.

Model III, 1968-69--As shown in Table 12, only small amounts of coarse grains moved under the conditions of Model III in 1968-69. All regions except one, nine, and ten were self-sufficient. These three regions, however, had large supplies of wheat during 1968-69. A total inventory of 94,267,000 bushels was accumulated.

Model III, 1969-70--Allocation of coarse grains in 1969-70 is shown in Table 13. Small amounts of coarse grain movement between regions two and one and also between regions nine and ten were indicated. Inventory adjustments from 1968-69 of 216,000 bushels to region fourteen and 7,979,000 bushels to region eighteen were included. Total inventory accumulation was 69,595,000 bushels.



Table 10  
SUPPLY AND DISPOSITION: MODEL III  
(Bushels of Barley Equivalent x 1000)

Region	1967-68		1968-69		1969-70	
	Supply	Demand	Supply	Demand	Supply	Demand
1	3,754	7,153	6,433	7,990	7,849	8,941
2	20,528	22,718	34,513	32,128	37,893	32,837
3	20,719	24,329	37,513	16,137	33,597	33,367
4	36,174	26,307	32,103	27,108	45,746	32,566
5	39,695	35,247	37,492	35,806	44,193	42,007
6	16,818	19,373	20,762	20,529	26,267	22,621
7	5,523	6,583	7,885	6,516	15,547	7,419
8	3,574	7,841	4,664	7,607	9,321	6,439
9	5,036	8,791	8,028	8,327	13,014	8,583
10	1,812	2,512	2,941	2,919	2,599	2,855
11	10,904	8,872	18,633	9,276	20,985	11,177
12	6,410	7,032	12,935	7,725	14,958	9,885
13	5,892	3,172	9,655	3,139	10,469	4,468
14	10,498	8,221	19,252	8,202	11,264	11,264
15	17,518	12,703	19,785	14,322	21,294	16,878
16	23,845	18,901	36,657	20,378	30,281	27,356
17	9,651	6,441	10,520	6,310	11,365	8,384
18	24,911	20,725	29,670	21,236	26,870	26,870
19		16,341		94,267		69,595

1. *Phlox subulata*

2. *Phlox paniculata*

3. *Phlox pilularis*

4. *Phlox maculata*

5. *Phlox subulata*

6. *Phlox paniculata*

7. *Phlox pilularis*

1. *Phlox subulata* 1. *Phlox subulata* 1. *Phlox subulata*  
2. *Phlox paniculata* 2. *Phlox paniculata* 2. *Phlox paniculata*  
3. *Phlox pilularis* 3. *Phlox pilularis* 3. *Phlox pilularis*  
4. *Phlox maculata* 4. *Phlox maculata* 4. *Phlox maculata*  
5. *Phlox subulata* 5. *Phlox subulata* 5. *Phlox subulata*  
6. *Phlox paniculata* 6. *Phlox paniculata* 6. *Phlox paniculata*  
7. *Phlox pilularis* 7. *Phlox pilularis* 7. *Phlox pilularis*



Table 11

## REGIONAL ALLOCATION: MODEL III, 1967-68

(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	3,754	1	1	3,754
2	2	20,528	2	2	20,528
3	3	20,719	3	3	20,719
4	2	1,617	4	2	2,561
4	4	26,307	4	4	26,307
4	6	2,555	4	6	2,555
4	19	5,061	4	19	2,561
5	1	319	5	1	838
5	2	519	5	3	3,610
5	3	3,610	5	5	35,247
5	5	35,247	6	6	16,818
6	6	16,818	7	7	5,523
7	7	5,523	8	8	3,574
8	8	3,574	9	9	5,036
9	9	5,036	10	10	1,812
10	10	1,812	11	7	1,060
11	8	2,032	11	8	972
11	11	8,872	11	11	8,872
12	12	6,410	12	12	6,410
13	1	2,720	13	10	658
13	13	3,172	13	12	622
14	8	2,235	13	13	3,172
14	12	42	13	19	1,440
14	14	8,221	14	8	2,277
15	1	360	14	14	8,221
15	9	3,755	15	8	1,018
15	10	700	15	9	3,755
15	15	12,703	15	10	42
16	7	1,060	15	15	12,703
16	16	18,901	16	16	18,901
16	19	3,884	16	19	4,944
17	17	6,441	17	17	6,441
17	19	3,210	17	19	3,210
18	18	20,725	18	18	20,725
18	19	4,186	18	19	4,186



Table 12  
REGIONAL ALLOCATION: MODEL III, 1968-69  
(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	6,433	1	1	6,433
2	1	1,557	2	1	1,557
2	2	32,138	2	2	32,138
2	19	828	2	19	828
3	3	16,137	3	3	16,137
2	19	21,827	3	19	21,827
4	4	27,108	4	4	27,108
4	19	4,995	4	19	4,995
5	5	35,806	5	5	35,806
5	19	1,686	5	19	1,686
6	6	20,529	6	6	20,529
6	19	233	6	19	233
7	7	6,516	7	7	6,516
7	19	1,369	7	19	1,369
8	8	4,664	8	8	4,664
9	9	8,028	9	9	8,028
10	9	22	10	9	22
10	10	2,919	10	10	2,919
11	8	2,943	11	8	2,943
11	11	9,276	11	11	9,276
11	19	6,444	11	19	6,444
12	9	277	12	9	277
12	12	7,725	12	12	7,725
12	19	4,933	12	19	4,933
13	13	3,139	13	13	3,139
13	19	6,516	13	19	6,516
14	14	8,202	14	14	8,202
14	19	11,050	14	19	11,050
15	15	14,322	15	15	14,322
15	19	5,463	15	19	5,463
16	16	20,378	16	16	20,378
16	19	16,279	16	19	16,279
17	17	6,310	17	17	6,310
17	19	4,210	17	19	4,210
18	18	21,236	18	18	21,236
18	19	8,434	18	19	8,434



Table 13

## REGIONAL ALLOCATION: MODEL III, 1969-70

(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	7,849	1	1	7,849
2	1	1,092	2	1	1,092
2	2	32,837	2	2	32,837
2	19	3,964	2	19	3,964
3	3	33,367	3	3	33,367
3	19	230	3	19	230
4	4	32,566	4	4	32,566
4	19	13,180	4	19	13,180
5	5	42,007	5	5	42,007
5	19	2,186	5	19	2,186
6	6	22,621	6	6	22,621
6	19	3,646	6	19	3,646
7	7	7,419	7	7	7,419
7	19	8,128	7	19	8,128
8	8	6,439	8	8	6,439
8	19	2,882	8	19	2,882
9	9	8,583	9	9	8,583
9	10	256	9	10	256
9	19	4,175	9	19	4,175
10	10	2,599	10	10	2,599
11	11	11,177	11	11	11,177
11	19	9,808	11	19	9,808
12	12	9,885	12	12	9,885
12	19	5,073	12	19	5,073
13	13	4,468	13	13	4,468
13	19	6,001	13	19	6,001
14	14	11,264	14	14	11,264
14	19	10,834	14	19	10,834
15	15	16,787	15	15	16,787
15	19	4,416	15	19	4,416
16	16	27,356	16	16	27,356
16	19	2,925	16	19	2,925
17	17	8,384	17	17	8,384
17	19	2,981	17	19	2,981
18	18	26,879	18	18	26,870
18	19	455	18	19	455



#### Model IV

Model IV is similar in nature to Model III. Wheat supplies are applied to demand for feed grain by poultry. Supply and disposition are shown in Table 4.

#### Results of Model IV

Model IV, 1967-68--Table 15 shows the allocation of wheat to feed use for 1967-68. Nine interregional movements were recorded. Imposition of the restrictions resulted in an increase in transportation costs of \$60,800. Increase in total inventory was 47,759,000 bushels.

Model IV, 1968-69--Allocation of wheat to feed uses for 1968-69 is shown in Table 16. Movements occurred from regions three and four to region five and from region four to region six. No inter-provincial movement was indicated. Movement into inventory totaled 153,737,000 bushels.

Model IV, 1969-70--The allocation of wheat under the conditions of Model IV is shown in Table 17. Movement of wheat occurred between six pairs of regions including interprovincial movement from region seven to region eighteen. The model included the following inventory adjustments. Region four's supplies were increased by 1,163,000 bushels, region sixteen was adjusted by 16,082 bushels, region seventeen was adjusted by 2,383,000 bushels from 1967-68 and 4,811,000 bushels from 1968-69, and region eighteen was adjusted by 1,089,000 bushels. Restriction of grains movement resulted in a deficit of 1,368,000 bushels for the province of Manitoba. This would be met through purchases from the Board, which would increase costs by the value of this grain less the laid-in value of wheat from region seven.





Table 14

SUPPLY AND DISPOSITION: MODEL IV  
(Bushels of Barley Equivalent x 1000)

Region	1967-68		1968-69		1969-70	
	Supply	Demand	Supply	Demand	Supply	Demand
1	311	498	8,749	444	7,674	744
2	13,176	3,437	26,751	2,981	15,130	4,941
3	892	2,887	5,522	2,545	1,000	4,309
4	11,524	3,000	5,402	2,632	12,700	4,351
5	2,085	5,765	730	5,085	615	8,576
6	933	2,173	1,711	1,899	2,734	3,122
7	5,388	524	4,989	466	21,091	798
8	1,890	786	3,248	695	27,568	1,171
9	- 5,532	1,825	8,703	923	45,560	1,559
10	- 2,730	298	4,886	264	2,263	455
11	3,278	2,260	18,928	2,000	31,014	3,276
12	9,062	1,249	30,033	1,105	33,275	1,859
13	14,575	980	11,793	519	13,717	882
14	4,758	930	17,758	870	8,333	1,485
15	13,041	3,903	5,804	824	6,609	1,371
16	9,971	1,109	19,586	3,504	6,405	6,176
17	4,353	16,458	5,789	978	11,107	1,718
18	9,529	48,665	15,811	14,722	- 2,260	25,897
19		47,759		153,737		186,943



Table 15  
 REGIONAL ALLOCATION: MODEL IV, 1967-68  
 (Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	311	1	1	311
2	1	167	2	1	167
2	2	3,437	2	2	3,467
2	3	1,995	2	3	1,995
2	10	1,216	2	19	7,577
2	19	6,361	3	3	892
3	3	892	4	4	3,000
4	4	3,000	4	5	3,680
4	5	3,680	4	6	1,240
4	6	1,240	4	19	3,604
4	19	3,604	5	5	2,085
5	5	2,085	6	6	933
6	6	943	7	7	524
7	7	524	7	19	4,864
7	19	4,864	8	8	786
8	8	786	8	9	1,104
8	9	1,104	11	11	2,260
11	11	2,260	11	19	1,018
11	19	1,018	12	9	1,317
12	9	1,317	12	10	1,216
12	12	1,249	12	12	1,249
12	19	6,496	12	19	5,826
13	13	883	13	13	583
13	19	7,144	13	19	7,144
14	14	980	14	14	980
14	19	3,778	14	19	3,778
15	15	930	15	15	930
15	19	12,111	15	19	12,111
16	16	3,903	16	16	3,903
16	18	6,068	16	18	6,068
17	17	1,109	17	17	1,109
17	18	861	17	18	861
17	19	2,383	17	19	2,383
18	18	9,529	18	18	9,529



Table 16  
REGIONAL ALLOCATION: MODEL IV, 1968-69  
(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	444	1	1	444
1	19	8,305	1	19	8,305
2	2	2,981	2	2	2,981
2	19	23,770	2	19	23,770
3	3	2,545	3	3	2,545
3	5	2,977	3	5	2,977
4	4	2,632	4	4	2,632
4	5	1,378	4	5	1,378
4	6	188	4	6	188
4	19	1,204	4	19	1,204
5	5	730	5	5	730
6	6	1,711	6	6	1,711
7	7	466	7	7	466
7	19	4,523	7	19	4,523
8	8	695	8	8	695
8	19	2,553	8	19	2,553
9	9	923	9	9	923
9	19	7,780	9	19	7,780
10	10	264	10	10	264
10	19	4,622	10	19	4,622
11	11	2,000	11	11	2,000
11	19	16,928	11	19	16,928
12	12	1,105	12	12	1,105
12	19	28,928	12	19	28,928
13	13	519	13	13	519
13	19	11,274	13	19	11,274
14	14	870	14	14	870
14	19	16,888	14	19	16,888
15	15	824	15	15	824
16	19	4,980	15	19	4,980
16	16	3,504	16	16	3,504
16	19	16,082	16	19	16,082
17	17	978	17	17	978
17	19	4,811	17	19	4,811
18	18	14,722	18	18	14,722
18	19	1,089	18	19	1,089



Table 17

## REGIONAL ALLOCATION: MODEL IV, 1969-70

(Bushels of Barley Equivalent x 1000)

Unrestricted Movement			Restricted Movement		
Origin (region)	Destination (region)	Volume	Origin (region)	Destination (region)	Volume
1	1	744	1	1	744
1	19	6,930	1	19	6,930
2	2	4,941	2	2	4,941
2	3	3,309	2	3	3,309
2	19	6,880	2	19	6,880
3	3	1,000	3	3	1,000
4	4	4,351	4	4	4,351
4	5	7,961	4	5	7,961
4	6	388	4	6	388
4	19	41	4	19	41
5	5	615	5	5	615
6	6	2,734	6	6	2,734
7	7	798	7	7	798
7	18	1,368	7	18	1,368
7	19	16,542	7	19	16,542
8	8	1,171	8	8	1,171
8	19	26,397	8	19	26,397
9	9	1,559	9	9	1,559
9	19	44,001	9	19	44,001
10	10	445	10	10	445
10	19	2,118	10	19	2,118
11	11	3,276	11	11	3,276
11	19	27,738	11	19	27,738
12	12	1,859	12	12	1,859
12	19	31,416	12	19	31,416
13	13	882	13	13	882
13	19	12,835	13	19	12,835
14	14	1,485	14	14	1,485
14	19	6,848	14	19	6,848
15	15	1,371	15	15	1,371
15	19	5,238	15	19	5,238
16	16	6,176	16	16	6,176
16	18	16,311	16	18	16,311
17	17	1,718	17	17	1,718
17	18	9,389	17	18	9,389
18	18	1,089	18	18	1,089





## Inventory

The following Table 18 shows the inventory flows specified by the analysis as compared to those derived from published sources. Differences are partially a result of the aggregation of data. Published sources include livestock feed, waste, and dockage as one category of disposition.

Table 18

### AGGREGATE INVENTORY ACCUMULATION

	Calculated Inventory Increase	Published Inventory Increase	% Difference from Total Supply
1967-68	64,100,000	28,600,000	9.8
1968-69	248,004,000	268,000,000	-3.6
1969-70	258,100,000	215,100,000	7.0

In that livestock demands in the analysis are based on this aggregation, total inventory will tend to be larger for this analysis than the inventory reported in published sources. The above differences will include waste, dockage, errors in the data, and error in the analysis.

### Interpretation of the Results

Movements of grain, as indicated in the various models used, were minimum movements. These volumes of grain were necessarily moved in order that demands for livestock feed could be met. Several factors would tend to increase movements beyond these minima. These factors include pricing policies, carryover and contingency, logistics, and data aggregation.



### Pricing Policies

For such reasons as surplus grains, low cash balances, and shortage of storage space, grain producers may adjust prices of their grain in order to increase sales. In this case, by incurring a portion of transportation costs, a producer may expand the area within which his grain is priced competitively. Thus through price discounting producers may develop markets for grain in other areas.

### Carryover and Contingency

The economic model provides for the carryover of grains from year to year for seed use only. Producers may retain larger volumes of grain for contingency purposes. In this case reduced quantities of grain would be available to the feed use markets.

### Logistics

The non-Board market for grains is characterized by a notable lack of market information. There is no comprehensive price information service and no centralized means of advertising quantities offered for sale or required by consumers. In addition to this information problem, much of the grain is stored in small amounts on widely dispersed producer inventories. Assembling such grain for shipment to a large consumer would result in severe logistical problems. Consequently, in many cases large volumes are purchased from large producers to assure continuing supplies. For this reason large amounts of grain are not available to all consumers. This may necessitate movement of grain from external sources or other regions.



### Data Aggregation

The spatial organization technique of analyzing markets tends to discount local movements of grains near the boundaries of the specified regions. The case of the existence of a trading area centered at a point near a boundary provides an example of movements that are not shown. This case also holds for trading centers on provincial borders in the Designated Area.

It must be emphasized that the volumes of movement specified in this analysis are minima. The movements of grain were necessarily larger than these minima. The actual volumes of movement are dictated by economic criteria as reflected in prices and price differentials.

### Pricing: Results of the Dual Solution

For each of the models described above, the price relationships between all regions entered in the solution are given. The model does not indicate real or actual prices, but rather indicates the relation between prices in all regions. By choosing one region as a base point, an indication of real prices may be derived. Because region five was included in all solutions showing significant amounts of grain movement, this region was set as the base point. This relation will be most accurate and reliable within Alberta (regions one through six, inclusive). From the prices and the transportation charges between all pairs of regions, the price to producers who choose to sell grain in region five can be deduced. Similarly, price relations can be specified for all pairs of regions given adequate price series for each base point. Because of the lack of reliable price data, base point prices were provided only for region five.



The dual prices for each model are shown in Appendix C. For each region in the respective solutions, the direction of movement and the relation of prices to those of the base point region are indicated on a map of the regions.

Examination of the price series presented in Appendix D indicates that, if these prices are correct, then significant variation in prices can exist even when relatively large volumes of grain are traded. From the analysis it is apparent that region five is a major feed grain consuming area. Price variations such as those shown between centers with region five indicate that price information is not widely disseminated within the region and that no one center provides an indicator of prices for the area.

#### Summary of the Analysis

Specification of supply and disposition of feed grains was provided as a basis for the transportation model. Solution of the model yielded a map of interregional movements. Under the condition of unrestricted movement, interprovincial movements were indicated for all models:

Model I	2,891,000 bushels
Model II	855,000 bushels
Model III	4,720,000 bushels
Model IV	2,584,000 bushels

Large amounts of grain were moved between regions:





	Model I	Model II	Model III	Model IV
1967-68	33,248,000	33,811,000	22,158,000	17,648,000
1968-69	3,866,000	3,059,000	4,799,000	4,543,000
1969-70	20,961,000	32,388,000	1,348,000	38,726,000

(Note that Model IV, 1969-70, was reduced by 1,368,000 under restricted movement.)

A thorough analysis of historical price series could not be carried out. If possible, this analysis would have been used to sensitize the transportation model solutions and to provide a price structure comparison to that of the dual solutions.

Model I provides the most reliable set of demands for feed grains. The model indicates the following disposition of grains for feed usage in bushels of barley equivalent:

	1967-68	1968-69	1969-70
Total Disposition	295,586,000	298,111,000	386,597,000

The assumption of complete indifference among sources of supply is implicitly most reasonable. Examination of the flows of grains and the regional demands under the assumptions of the various models indicates that Model I provides the most accurate simulation of the prairie non-Board feed grains market. With the exception of poultry, for which a high-energy grain such as wheat is required, the buyer of grains for animal feed bases his purchasing decisions largely on the prices of alternative grains. Given equivalent prices for wheat, oats, and barley, he will tend to be indifferent to supplies. Model I provides an analysis based on the premise of indifference.



Oats, barley, and mixed grains have traditionally been considered the major or only grains to be used for livestock feeding. Recent increases in stocks of wheat on farms have resulted in the increased use of this grain as livestock feed. In the 1969-70 crop year, disposition of wheat for animal feed increased sharply from previous levels [DBS, various issues], suggesting increased use of wheat for livestock feed. For this reason the results of Model IV 1969-70, are not as accurate as those of Model IV, 1967-68, or Model IV, 1968-69. As Model II is an aggregation including the data of Model IV, the results of this model will also show distortion in favor of the major poultry producing regions.

The extent to which the models considered above conform to actual or estimated data has been noted. Because precise data cannot be obtained on actual interregional movements of grain, the models must also be judged on the reasonability and usability of their results. Various grain trade personnel indicated in interviews that they could verify many of the movements on the basis of personal experience. For these reasons the results of Model I are considered to be most accurate and useful.

From the above analysis and discussion, it is apparent that the restrictions do have an adverse and partially measurable effect on the marketing costs of the non-Board feed grains market. The necessity of making an arbitrary distinction between different supplies of feed grains given temporary or lasting deficits in various regions will reduce market efficiency through increasing costs of transportation services.



The results of the questionnaire, insights gained through interviews, and a survey of the literature all indicate concern among producers and the trade about price information. As shown above, prices tend to be highly variable between and within regions. There is very little accurate price data available, even on an historical basis. Producers indicate that this reduces their bargaining power in the market and makes planning of farm operations more difficult.

It is apparent that gains in market efficiency may be realized by removing the restrictions on interprovincial movement of grains. The incidence of these gains, however, must be an important factor in any decision regarding their removal. Given the present flow of market information to the producer of feed grains, it is doubtful that producers would realize the full extent of the available gains. If the producer had access to adequate feed grain price information, the position of the traders in the market would be enhanced by allowing a larger trading area for buyers and sellers. In this way competitive price structures would be evident and a more responsive price series would occur.

#### Weaknesses

Several weaknesses are inherent in the above analysis. Given the nature and complexity of the prairie non-Board feed grains market, this study does not include a complete description or a complete analysis of the marketing channel.

The primary constraint upon an analysis of interregional feed grains movement is the availability and accuracy of price data. For



this reason the above analysis can only provide minimum movements. Further definitive analysis will require extensive, reliable price data on a regional basis. With this information it is possible to use other means of analysis providing measures of the elasticity of supply and demand on a regional basis. Thus the pricing policies of producers and feed grain users may be included and a more accurate simulation provided.

An important weakness of this analysis is inherent in the transportation rate structure. The rates as presented in Chapter IV were rounded to two digits. This resulted in the possibility of two entries in the solution at equal tariffs. In this case a unique solution cannot be forced. Greater accuracy in transportation rates would have tended to reduce this problem. Two solutions affected by this problem are present in second best, or last suboptimal, form.





## CHAPTER VI

### SUMMARY AND CONCLUSIONS

The prairie non-Board feed grains market is an important sector of the agribusiness system. Annual requirements for livestock feed in the Designated Area exceed three hundred million bushels. Growth of this market is directly linked to expansion of livestock and poultry production in the prairies. The stability of this market is, however, contingent upon Board marketing opportunities and regional production of grains. The two markets cannot be considered in isolation. The importance of both export and domestic feed grains markets makes this increasingly apparent. Because of difficulties in controlling the market, it has never been successfully administered by the Board.

As a general rule the design of feed grains policies has not considered the prairie non-Board market. The impact of grains policies on the livestock and poultry industries, although very significant, has had little or no consideration in evaluation of these policies. Restriction of grains movement within the Designated Area may be viewed in this light.

Although demands for feed grains can largely be supplied from within the respective provinces, from time to time it is necessary that feed grains be transported across provincial borders to meet livestock feed requirements.

The study provides a description of minimum interregional movements of feed grains. Supply and disposition data are derived such that all grain in regional inventories is available for feed use and



can be transported to deficit regions. Supplies of grain retained for contingency purposes and wasted grain are not considered. Quantification of these factors would have increased interregional movements. Other factors which would also tend to increase movements include discount pricing by producers in high inventory areas and the varying costs of assembling large quantities of grain. It must be emphasized that the volumes of movement presented in this analysis are extreme minima and not actual movements.

The quantities of grains drawn from regional inventories indicate that movement of grain is affected by Board sales of grain and also by quota policy. These factors affect grain movement for both feed use and deliveries to elevators. The occurrence of grains' movement at under the above specifications given large surplus grain stocks would suggest consistent movement of grains in the study area. Further indication of the relation of minimal movements to actual movement can be derived from the varying volumes shown for the respective models presented.

There is a strong economic incentive for the movement of grains interregionally for feed requirements. Effective restriction in the case of required movements cannot be maintained. The restrictions cannot be justified by means of economic criteria.

The hypothesis that the restrictions on movement on feed grains interprovincially within the Designated Area enhanced market efficiency in the prairie non-Board feed grains market cannot be accepted. The results of this analysis indicate that the restriction of feed grain movement is not beneficial to prairie agriculture.



There are, however, both economic and political aspects to the problem. This study does not investigate the latter which lie beyond the terms of reference of this study.

The removal of restrictions on a legislative basis could be easily achieved. The annual extension of Parts III and IV of the Canadian Wheat Board Act by Order-in-Council to include the marketing of oats and barley could be made exclusive of the power to control interprovincial movement within the Designated Area [Jones, 1971]. There are, however, an alternative means to achieve the same end.

Provision for the movement of grains within the Designated Area may be achieved as dictated by regional supplies and demands. Board control could be maintained through the free use of permits issued by the Board under Part IV of the Canadian Wheat Board Act to move grain interprovincially. Such a provision could also provide information on physical movements of grain and on the prices at which trading occurs. In this way the Board could better serve producer interests. Given conditions of short supply, the Board could better judge the prices that must be paid to obtain required supplies. Only through such competitive bidding could control of movements, if necessary be maintained. Under such bidding nonissuance of permits would be meaningful. The enforcement of a regulation for which no purpose can be specified does not appear to reflect objective nor rational administration. Criticism on such a basis tends to affect adversely the acceptance of other critically important objectives administered by the Board.



Producer opinions on the impact of the restrictions could not be documented. A questionnaire distributed widely among farmers did not elicit a significant number of responses. This may indicate a lack of concern among producers about the importance of the problem.

### Recommendations

Feed grains policy must be designed, implemented, and analyzed within the context and interests of both the producer of feed grains and the producer of livestock and poultry. Only then can the interests of prairie farmers be served. The following recommendations are suggested to improve the marketing efficiency of the prairie non-Board market for feed grains.

Provision for the movement of grains interprovincially should be made. This would have significantly favorable effects on prairie agriculture, both in terms of direct costs of physical movement and in terms of the pricing of grains in all areas affected by legal restrictions. As there is no economic justification for the retention of the restrictions of grains movement, the primary recommendation of this study must be that these interprovincial restrictions within the Designated Area be effectively removed or legally eliminated, whichever provides the greater benefit to prairie agriculture.

Secondly, a means for collecting feed grains price information is urgently needed by traders of feed grains. Toward this end, a study should be conducted to specify the requirements of buyers and sellers in terms of quantity and quality of price information and to determine an effective means of providing this service. Very little is known







about the process of price discovery in the feed grains market. This lack of knowledge has resulted in the current state of confusion regarding non-Board prices and accuracy of various series of published data. The approach has traditionally been to collect prices without identifying the price making forces that determine feed grains prices. In order to understand the price discovery process, the nature of the market must be understood. The study should relate existing knowledge of pricing to the marketing of feed grains and to the marketing of the products for which feed grains are an input. In this way the inter-temporal, interspatial, and quality aspects of pricing could be understood and a solid basis for price analysis provided.

Alternative means for dissemination of this price information such as a subscriber service should be examined.

In addition to feed grain price information accurate inventory and supply data should be made available to farmers. Updating of this analysis from time to time would provide useful information from which to estimate on farm inventory and disposition of feed grains. The use of this analysis with occasional surveys of on farm storage would provide adequate quantity information.

This study was necessarily limited by the complexity of the subject and by the available data series. The study can be extended in several respects. The analysis could be organized on a quarterly rather than an annual basis. Processing and storage functions could be included if data were available. In this way movements to and from inventory and processing plants could be made more specific for each



region. Extension of the analysis to provide greater comparison among the various models and to sensitize programs characterized by alternate optimal solutions could have been carried out had more time been available. The risk factor could also have been included to determine immediate effects of the restrictions. Estimation of factors influencing movement in excess of the minimum levels would have contributed to the usefulness of the analysis.

Traditional interest in export markets for grain has resulted in almost ignoring domestic feed grain markets. In order for the marketing of non-Board grains to occur in a more orderly fashion, additional knowledge is necessary.

Although many minor revisions would foster the development of the non-Board market, two major changes are herein recommended. This study has provided some direction toward these ends. Further action and study would be of significant benefit to this important sector of prairie agriculture.



## BIBLIOGRAPHY

- ALBERTA DEPARTMENT OF AGRICULTURE, 1966. Alberta Cow-Calf Enterprise Analysis. Edmonton: ADA.
- ALBERTA DEPARTMENT OF AGRICULTURE, 1966. Alberta Farm Business Analysis. Edmonton: ADA.
- ALBERTA DEPARTMENT OF AGRICULTURE, 1965-66 through 1969-70. Statistics of Agriculture for Alberta. Edmonton: ADA.
- ALBERTA WHEAT POOL, 1970. Wheat Pool Budget, 21:12, February.
- BRAY, N., 1971. Agricultural Statistician, Economics and Statistics Branch, Saskatchewan Department of Agriculture, Regina. (Unpublished data.)
- BRAY, N., 1971. "Estimated Livestock Population on Farms in Saskatchewan." Regina: SDA. (Unpublished data.)
- CANADA DEPARTMENT OF AGRICULTURE, 1967 through 1970. Livestock Market Review. Ottawa: CDA.
- CANADA DEPARTMENT OF AGRICULTURE, 1967 through 1970. Origin of Live-stock Marketed. Ottawa: CDA.
- CANADA GRAINS COUNCIL, 1970. Feed Grains of Canada. Winnipeg: CGC.
- CANADIAN WHEAT BOARD, n.d. The Canadian Wheat Board. Winnipeg: CWB.
- CANADIAN WHEAT BOARD, 1970. "Non Quota Feed Mill Policy and the Interprovincial Movement of Wheat, Oats and Barley." Presentation to House of Commons Standing Committee on Agriculture, March 10.
- CARLSON, G.C., 1970. A Background Paper on Feed Grains Marketing in Canada. Regina: Canadian Federation of Agriculture.
- COMBS *et al.*, 1970. Dairy Cattle Production in Alberta. Edmonton: University of Alberta, Department of Animal Science.
- CRADDOCK, W.J., 1970. Interregional Competition in Canadian Cereal Production. Ottawa: Economic Council of Canada, Queen's Printer, March.
- DENNIS, C.C. and C.L. Sammet, 1961. "Interregional Competition in the Frozen Strawberry Industry." Hilgardia, 31:15, July.



- DOMINION BUREAU OF STATISTICS, 1966-67 through 1969-70. Grain Trade of Canada. Catalogue No. 22-201. Ottawa: Queen's Printer.
- DORFMAN, R., R.A. Samuelson and R.M. Solow, 1958. Linear Programming and Economic Analysis. New York: McGraw-Hill Book Company.
- ECONOMIC COUNCIL OF CANADA, 1964. First Annual Review: Economic Goals For Canada to 1970. Ottawa: Queen's Printer, December.
- ENKE, S., 1941. "Equilibrium Among Spatially Separated Markets: Solution by Electric Analogue." Econometrica, 18, pp. 40-48.
- FEDERAL TASK FORCE ON AGRICULTURE, 1969. Canadian Agriculture in the Seventies. Ottawa: Queen's Printer, December.
- FETTER, F.A., 1924. "The Economic Law of Market Areas." Quarterly Journal of Economics, 38, pp. 520-29.
- HENRY, W.R. and C.E. Bishop, 1957. North Carolina Broilers in Inter-regional Competition. Agricultural Economics Information Series Bulletin No. 56. Raleigh, North Carolina: North Carolina State College.
- HICKS, J.R., 1939. Value and Capital. 2nd ed. London: Oxford University Press, pp. 55-111.
- HITCHCOCK, F.L., 1941. "The Distribution of a Product from Several Sources to Numerous Localities." Journal of Mathematics and Physics, 20, pp. 225-230.
- HOOVER, E.M., 1948. The Location of Economic Activity. New York: McGraw-Hill Book Company.
- HUGHES, A.A., 1971. Supervisor, Dairy Herd Improvement, Dairy Branch, Alberta Department of Agriculture, Edmonton. Telephone conversation.
- HUGHES, A.A., 1968. "An Address to the Alberta Dairymen's Association". Edmonton.
- JOHNSON, G.O., 1971. Poultry Branch, Alberta Department of Agriculture, Edmonton. Telephone conversation.
- JONES, F.D., 1971. Faculty of Law, University of Alberta, Edmonton. Telephone conversation.
- KERR, T.C., 1966. An Economic Analysis of the Feed Freight Assistance Policy. Ottawa: Agricultural Economics Research Council.
- KOOPMANS, T.C., ed., 1951. Activity Analysis of Production and Allocation. Cowles Commission Monograph No. 13. New York: John Wiley and Sons, pp. 229-259.







- KOOPMANS, T.C., 1949. "Optimum Utilization of the Transportation System." Econometrica, 17, pp. 136-146.
- LEROHL, M.L. *et al.*, 1970. The Benefits and Burdens of Feedgrain Transportation Policy. Ottawa: Agricultural Economics Research Council of Canada.
- LOSCH, A., 1954. The Economics of Location. Translated by William H. Woglom with the assistance of Wolfgang F. Stolper. New Haven: Yale University Press.
- LOVE, H.C., 1969. "Determinants of Forage Use in Livestock Production of the Prairies--1980." Materials presented at Canadian Forage Crops Symposium, University of Alberta, Edmonton, May.
- MANITOBA DEPARTMENT OF AGRICULTURE, 1965 through 1970. Yearbook of Manitoba Agriculture. Winnipeg: MDA.
- MARRITT, E.F., 1970. An Assessment of the Canadian Feed Grains Market. Winnipeg: Canada Grains Council.
- MARSHALL, A., 1922. Principles of Economics. 8th ed. London: MacMillan and Co. Ltd.
- MENZIES, M.W. *et al.*, 1970. Report of the Canadian Grain Marketing Review Committee. Winnipeg: CWB.
- NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL, 1966. Nutrient Requirements for Beef Cattle. Washington, D.C.: National Academy of Sciences.
- NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL, 1966. Nutrient Requirements of Dairy Cattle. Washington, D.C.: National Academy of Sciences.
- PORTER, K.D., 1970. Dairy Farm Business Summary. Edmonton: Alberta Department of Agriculture.
- REVISED STATUTES OF ALBERTA, 1955. The Coarse Grain Marketing Control Act. Edmonton: King's Printer, Chapter 12.
- REVISED STATUTES OF CANADA, 1952. The Canadian Wheat Board Act. Ottawa: Queen's Printer, Vol. 11, Chapter 44.
- REVISED STATUTES OF CANADA, 1970. The Canadian Wheat Board Act. Ottawa: Queen's Printer, Vol. 11, Chapter 12.
- REVISED STATUTES OF MANITOBA, 1970. The Coarse Grains Marketing Control Act. Winnipeg: Queen's Printer, Chapter C140.



- REVISED STATUTES OF SASKATCHEWAN, 1965. The Saskatchewan Grain Marketing Control Act. Regina: Queen's Printer, Chapter 241.
- RURAL FEED MILLS ASSOCIATION, 1970. Submission to the Standing Committee on Agriculture. March.
- SAMUELSON, P.A., 1961. Foundations of Economic Analysis. Cambridge: Harvard University Press, pp. 259-275.
- SAMUELSON, P.A., 1952. "Spatial Price Equilibrium and Linear Programming." American Economic Review, 42, pp. 283-303.
- SNODGRASS, M.M. AND C.E. French, 1958. Linear Programming Approach to the Study of Interregional Competition in Dairying. Agricultural Experiment Station Bulletin 637. Lafayette, Indiana: Agricultural Experiment Station, May.
- STATUTES OF ALBERTA, 1951. An Act to Amend the Coarse Grain Marketing Control Act. Edmonton: King's Printer, Chapter 49.
- STATUTES OF CANADA, 1939. An Act to Amend the Canadian Wheat Board Act. Ottawa: King's Printer, Chapter 39.
- STATUTES OF CANADA, 1947. An Act to Amend the Canadian Wheat Board Act. Ottawa: King's Printer, Chapter 15.
- STATUTES OF CANADA, 1935. The Canadian Wheat Board Act. Ottawa: King's Printer, Chapter 53.
- WALKER, F.E., 1964. "Transportation and Spatial Equilibrium Models for Inter-regional Analysis." Paper presented at Southern Farm Management Research Committee Workshop, New Orleans, March 23-24.
- WEBER, A., 1929. Theory of the Location of Industries. Translated by C.J. Friedrich. Chicago: University of Chicago Press.
- WESTERN TRANSPORTATION ASSOCIATION, 1971. "Tariff #345." Calgary, Alberta: Western Transportation Association.



## APPENDICES



## APPENDIX A





# INTERREGIONAL TRANSPORTATION RATES

(Cents per Bushel of Barley Equivalent)<sup>1</sup>

Region	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1 Medicine Hat	0	18	21	30	26	30	30	25	18	18	29	25	25	31	26	32	32	37	40
2 Brooks	18	0	18	26	23	18	32	28	21	18	31	26	23	32	18	35	34	18	40
3 Calgary	21	18	0	25	18	23	36	31	26	23	35	29	35	33	30	38	38	39	40
4 Vermillion	30	26	25	0	19	20	32	28	26	30	39	21	19	28	18	35	32	39	40
5 Wetaskwin	26	23	18	19	0	18	38	34	30	28	33	26	21	31	23	39	37	39	40
6 Westlock	30	28	23	20	18	0	38	33	34	32	35	29	26	33	25	39	38	39	40
7 Carlyle	30	32	36	32	38	38	0	19	25	28	18	25	30	26	29	18	23	23	40
8 Regina	25	28	31	28	34	33	19	0	19	23	18	19	24	20	23	23	23	38	40
9 Swift Current	18	21	26	26	30	34	25	19	0	18	23	20	21	26	21	28	29	32	40
10 Maple Creek	18	18	23	30	28	32	28	23	18	0	26	23	24	30	24	31	32	35	40
11 Yorkton	29	31	35	30	33	35	18	18	23	26	0	21	25	20	25	21	18	25	40
12 Saskatoon	25	26	29	21	26	29	25	19	20	23	21	0	18	19	18	29	25	32	40
13 Kerrobert	25	23	25	19	21	26	30	24	21	24	25	18	0	24	18	29	30	32	40
14 Melfort	31	32	33	28	31	33	26	20	26	30	20	19	24	0	21	28	25	32	40
15 Battleford	26	28	30	18	23	25	29	23	21	24	25	18	18	21	0	21	30	28	40
16 Brandon	32	35	38	35	39	39	18	23	28	31	21	29	29	28	31	0	18	18	40
17 Dauphin	32	34	38	32	37	38	23	23	29	32	18	25	30	25	30	18	0	21	40
18 Winnipeg	37	38	39	39	39	39	23	28	32	35	25	32	32	32	35	18	21	0	40
19 Inventory	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40

<sup>1</sup>Derived from Western Transportation Association, "Tariff #345" (Calgary, Alberta: Western Transportation Association, 1971).



## APPENDIX B



## INTERTEMPORAL INVENTORY FLOWS

(Bushels of Barley Equivalent x 1000)

---

<u>Model I, 1968-69 to 1969-70</u>			
Region	Available Inventory	Inventory Flow	Inventory Usage
3	21,846	13,298	8,548
16	32,396	20,803	11,593
18	12,761		12,761

---

<u>Model II, 1968-69 to 1969-70</u>			
Region	Available Inventory	Inventory Flow	Inventory Usage
3	22,135	16,584	5,551
6	45		45
16	32,361	8,903	23,458
18	9,523		9,523

---

<u>Model III, 1968-69 to 1969-70</u>			
Region	Available Inventory	Inventory Flow	Inventory Usage
14	11,050	10,834	216
18	8,434	455	7,979

---

<u>Model IV, 1967-68 to 1969-70</u>			
Region	Available Inventory	Inventory Flow	Inventory Usage
17	2,383		2,383

---

(continued...)



---

Model IV, 1968-69 to 1969-70

Region	Available Inventory	Inventory Flow	Inventory Usage
4	1,204	41	1,163
16	16,082		16,082
17	4,811		4,811
18	1,089		1,089

---

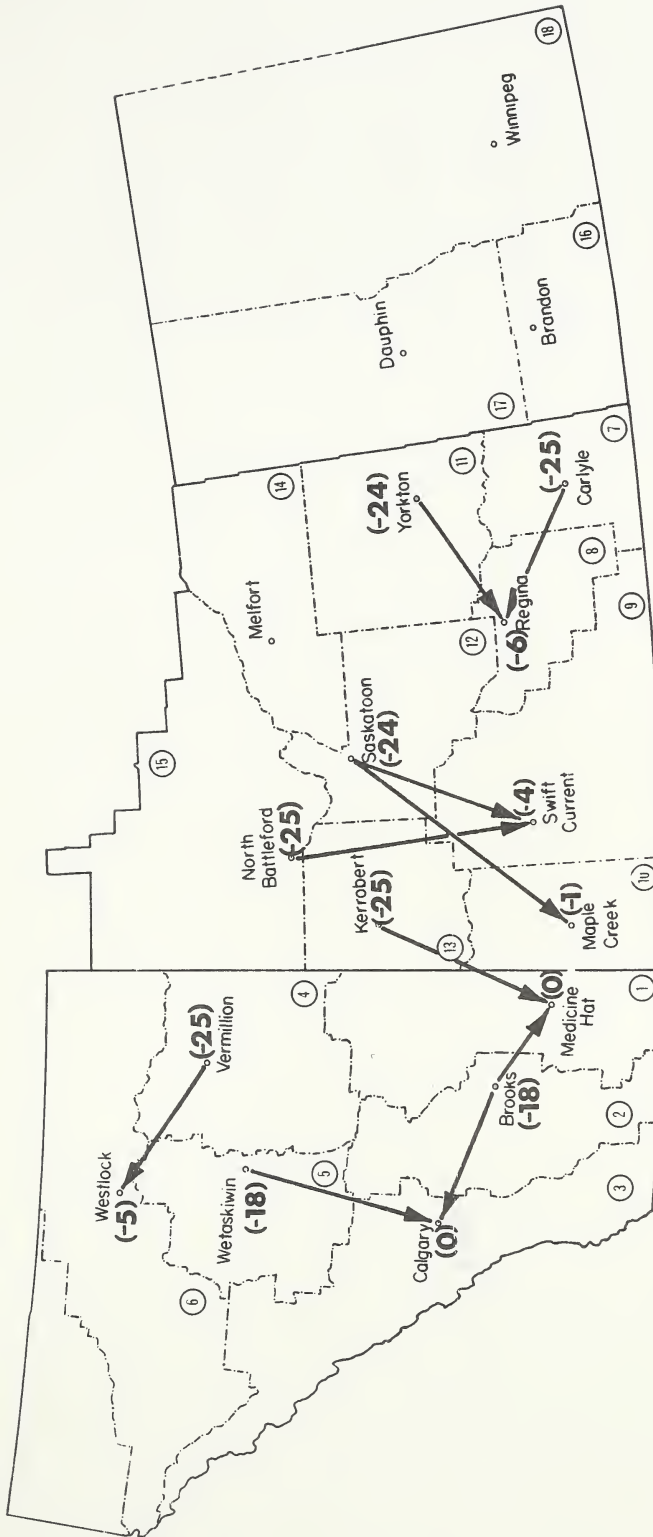




APPENDIX C

GEOGRAPHICAL FEED GRAIN MOVEMENTS  
AND PRICE DIFFERENTIALS

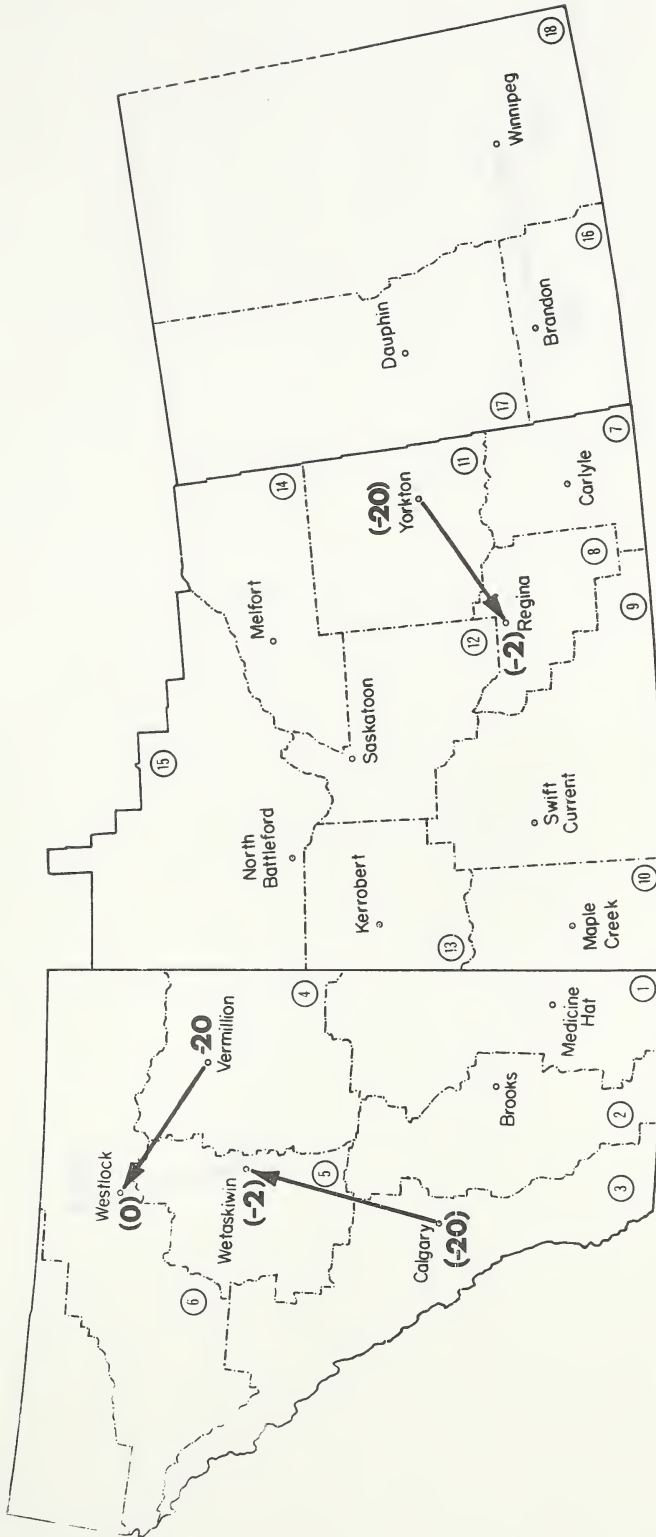




GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL I, 1967-68

Note: Numbers in parentheses indicate dual prices.





GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL I, 1968-69

*Note: Numbers in parentheses indicate dual prices.*



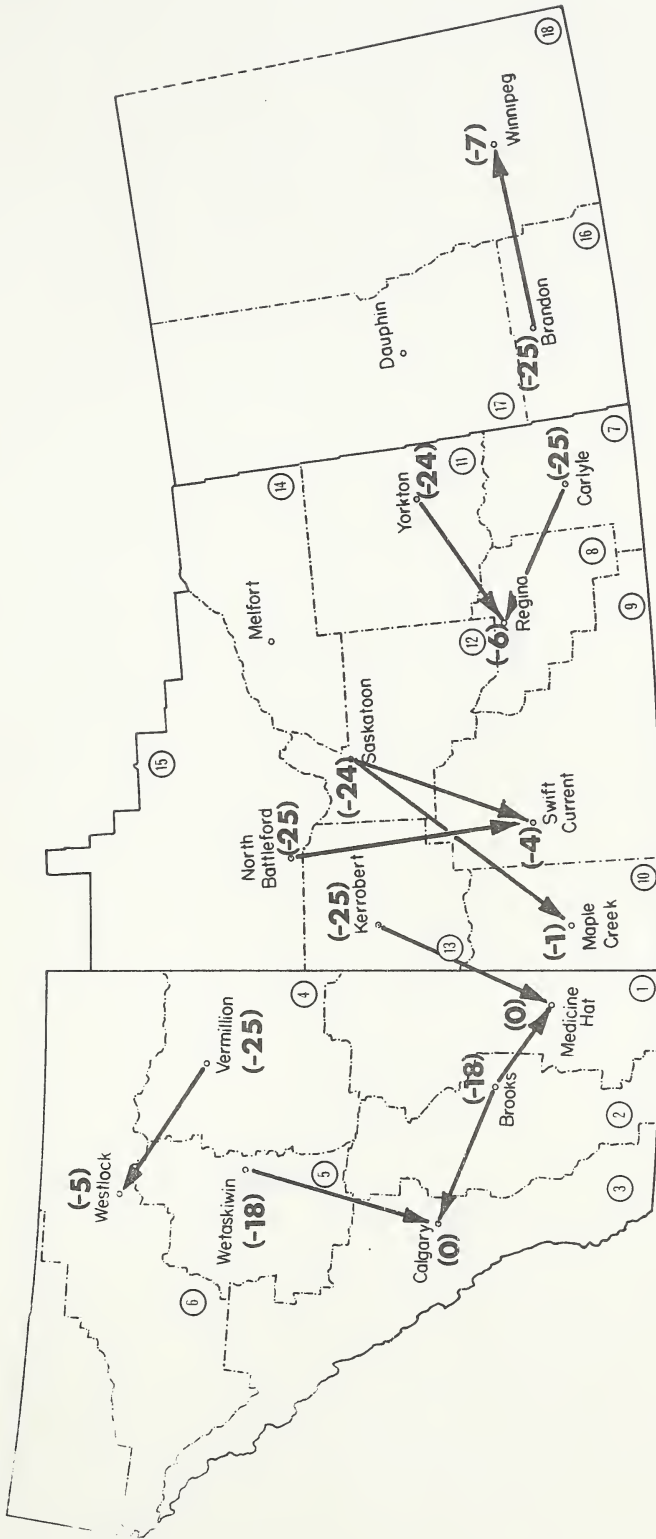


GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL I, 1969-70

*Note: Numbers in parentheses indicate dual prices.*



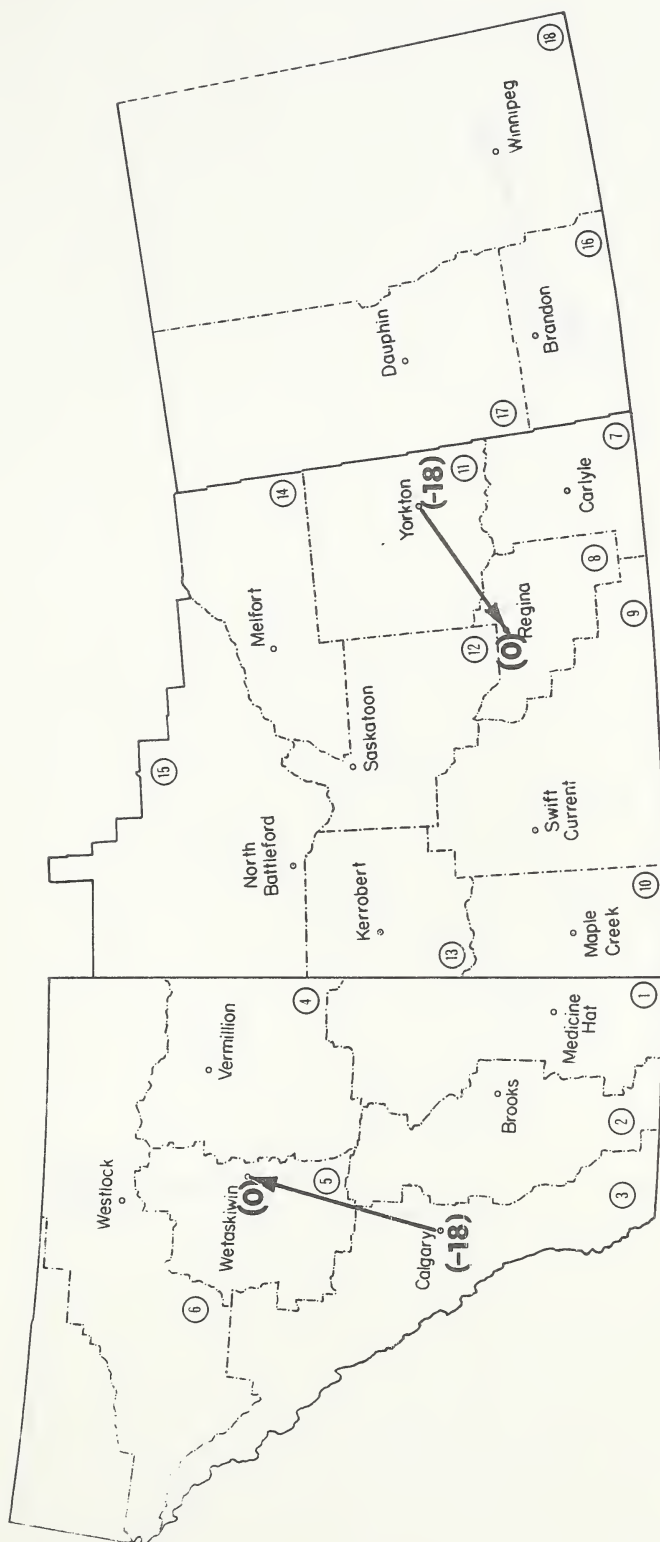




GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL II, 1967-68

*Note: Numbers in parentheses indicate dual prices.*

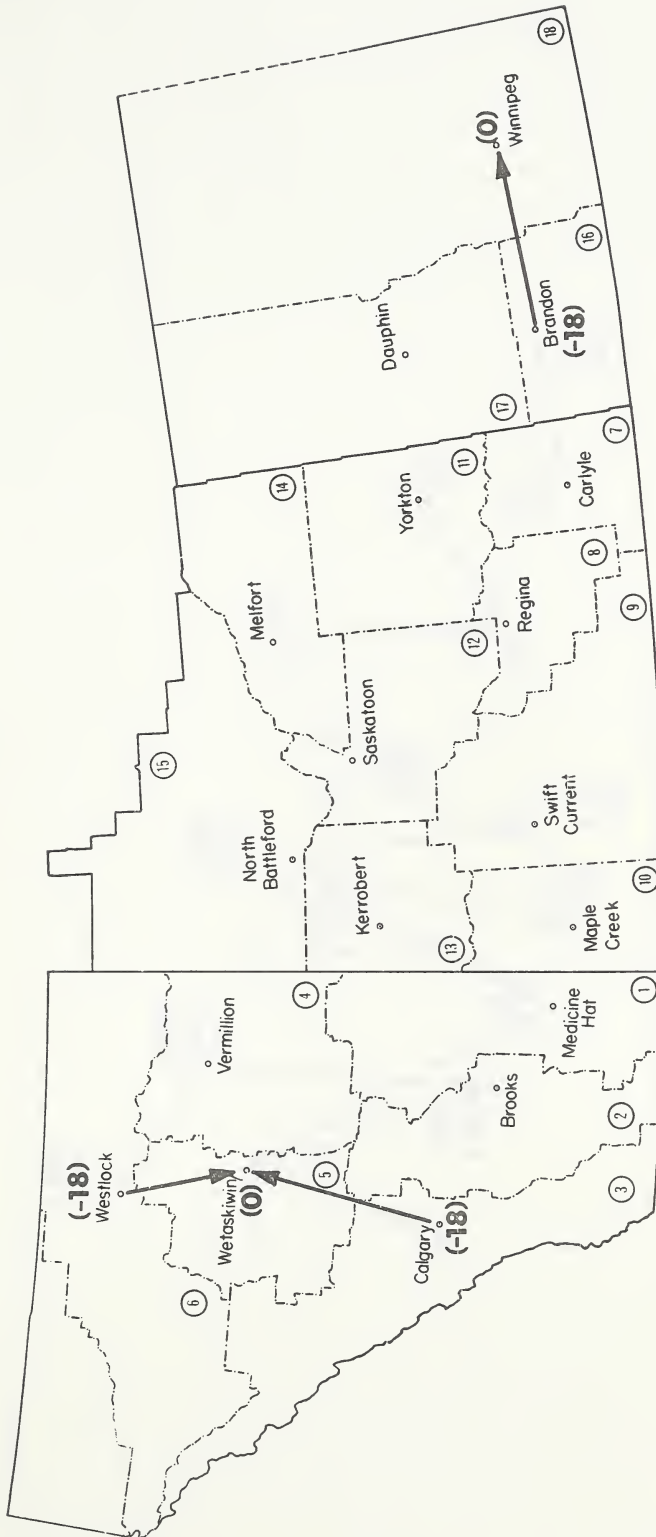




GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL II, 1968-69

*Note: Numbers in parentheses indicate dual prices.*

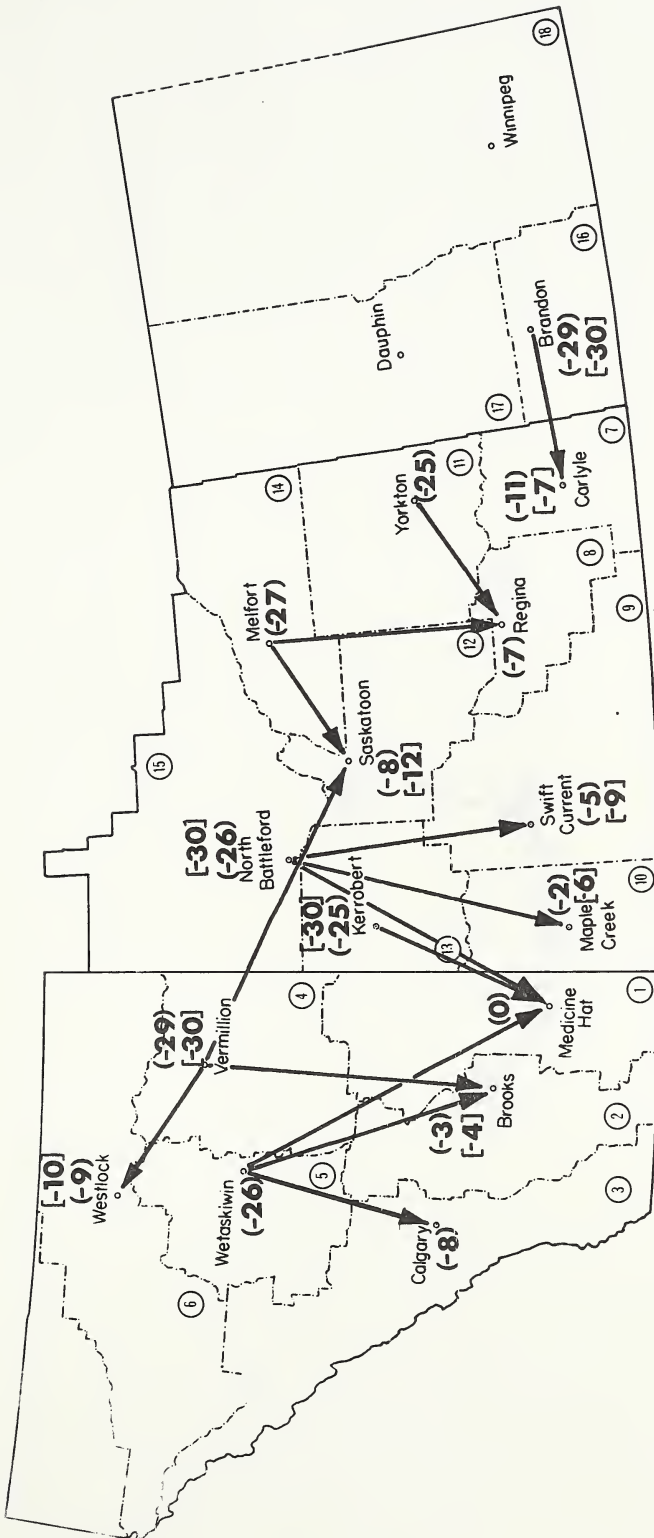




GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL II, 1969-70

*Note: Numbers in parentheses indicate dual prices.*



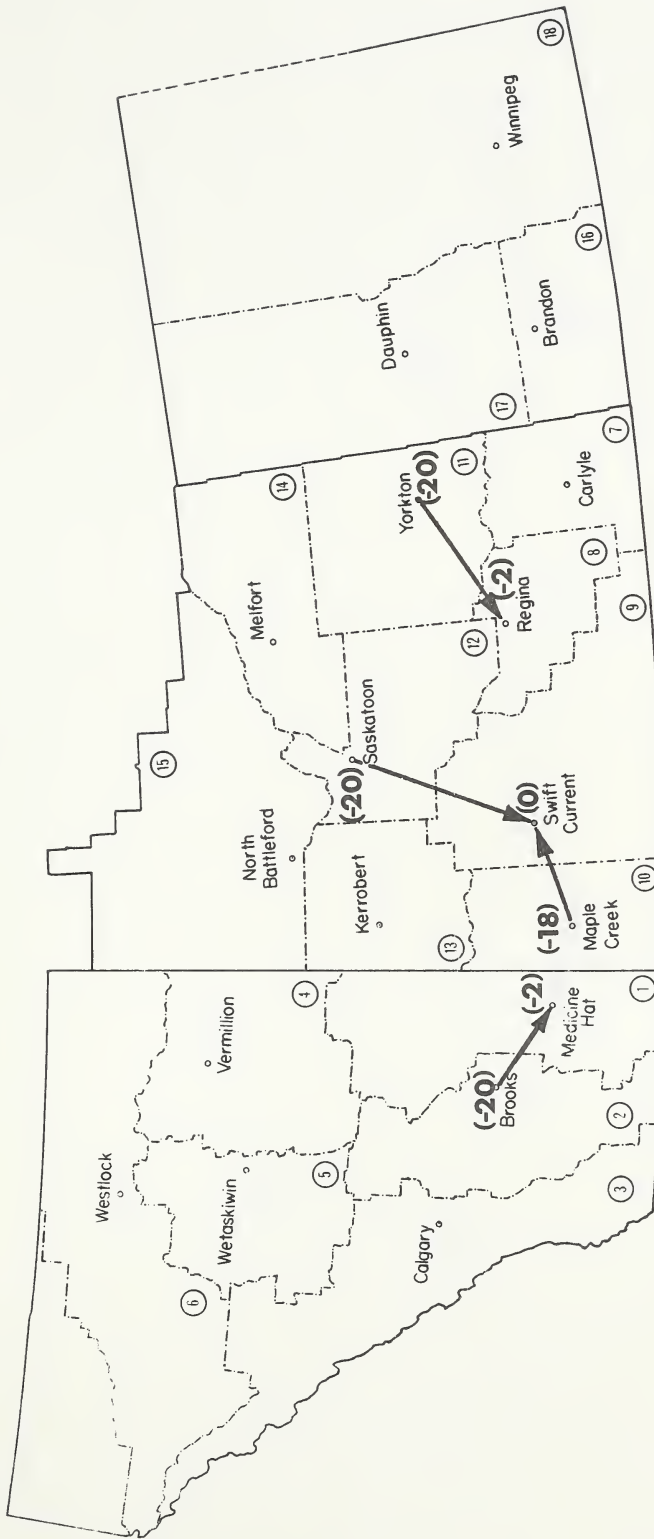


GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL III, 1967-68

Note: Numbers in parentheses indicate dual prices under unrestricted grains movement.  
Numbers in brackets indicate dual prices under restricted grains movement.







GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL III, 1968-69

*Note: Numbers in parentheses indicate dual prices.*

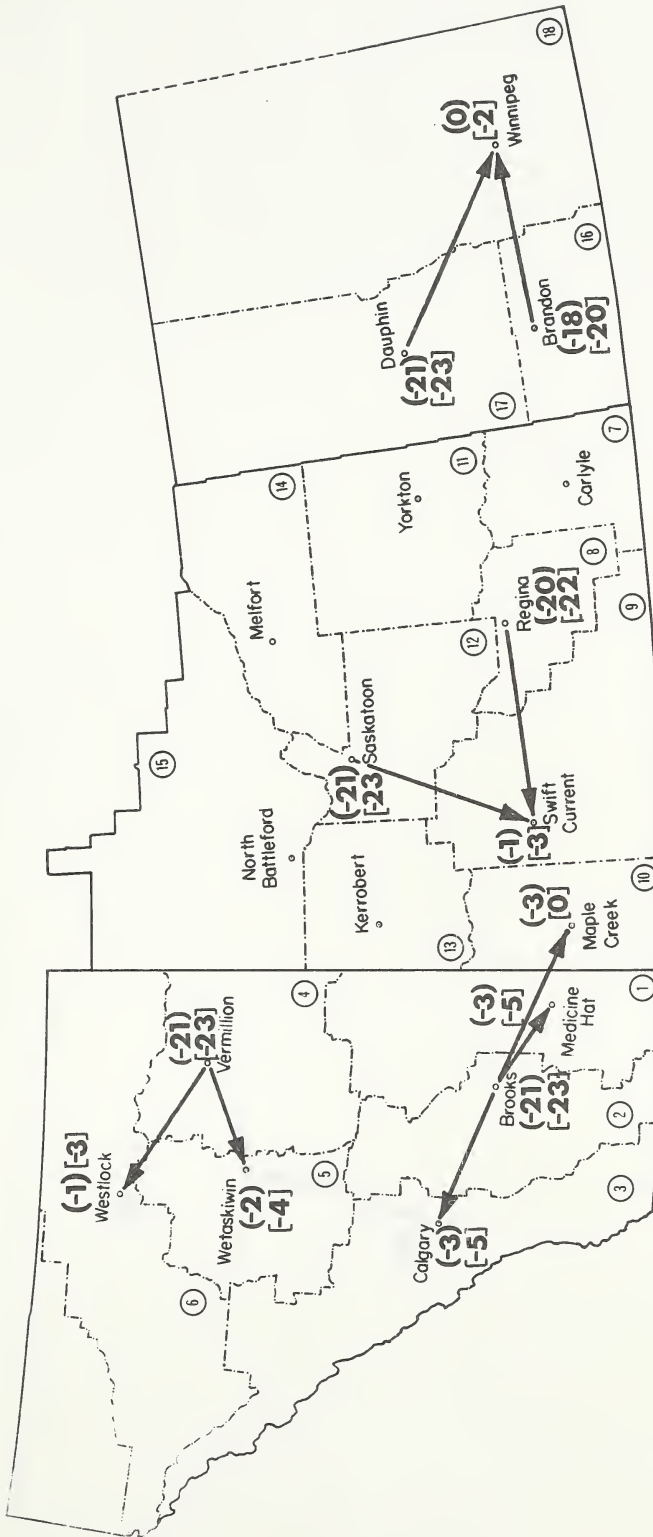




GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL III, 1969-70

Note: Numbers in parentheses indicate dual prices.

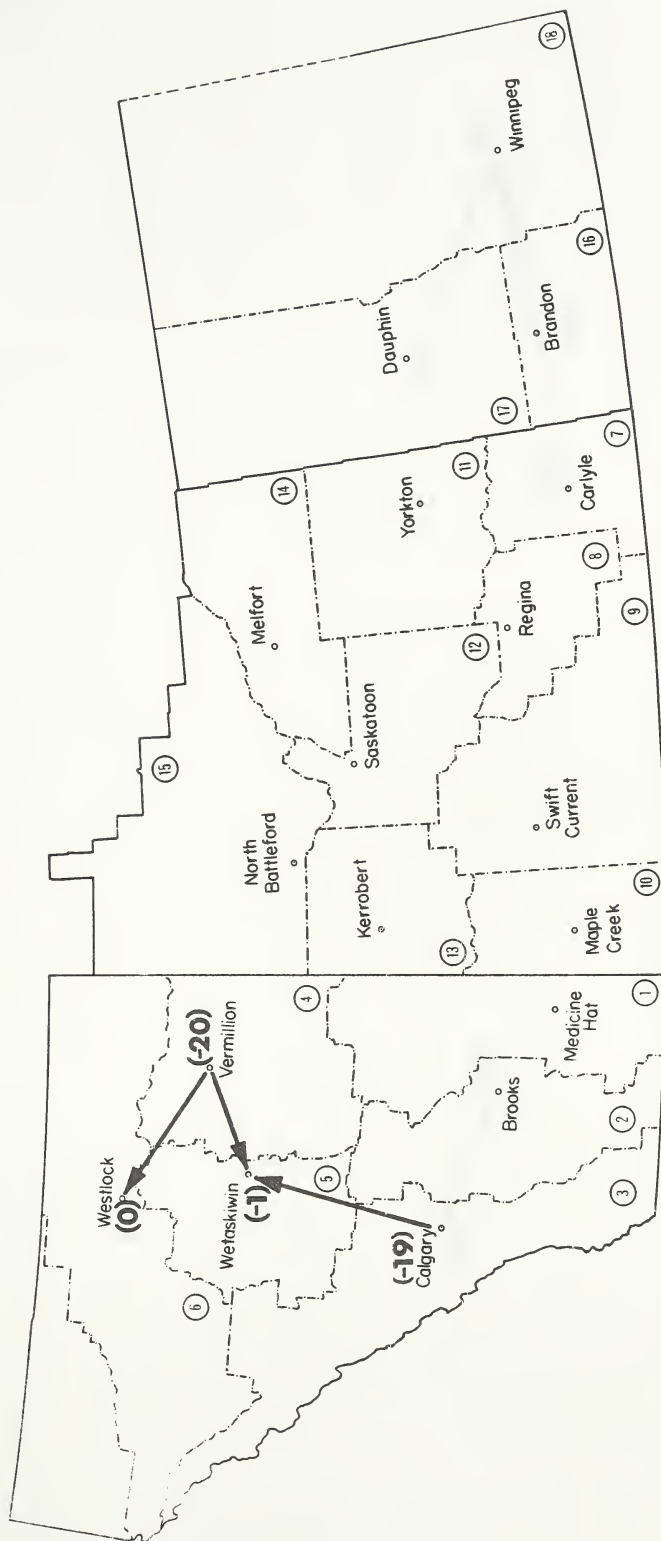




GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL IV, 1967-68

Note: Numbers in parentheses indicate dual prices under unrestricted grains movement.  
Numbers in brackets indicate dual prices under restricted grains movement.



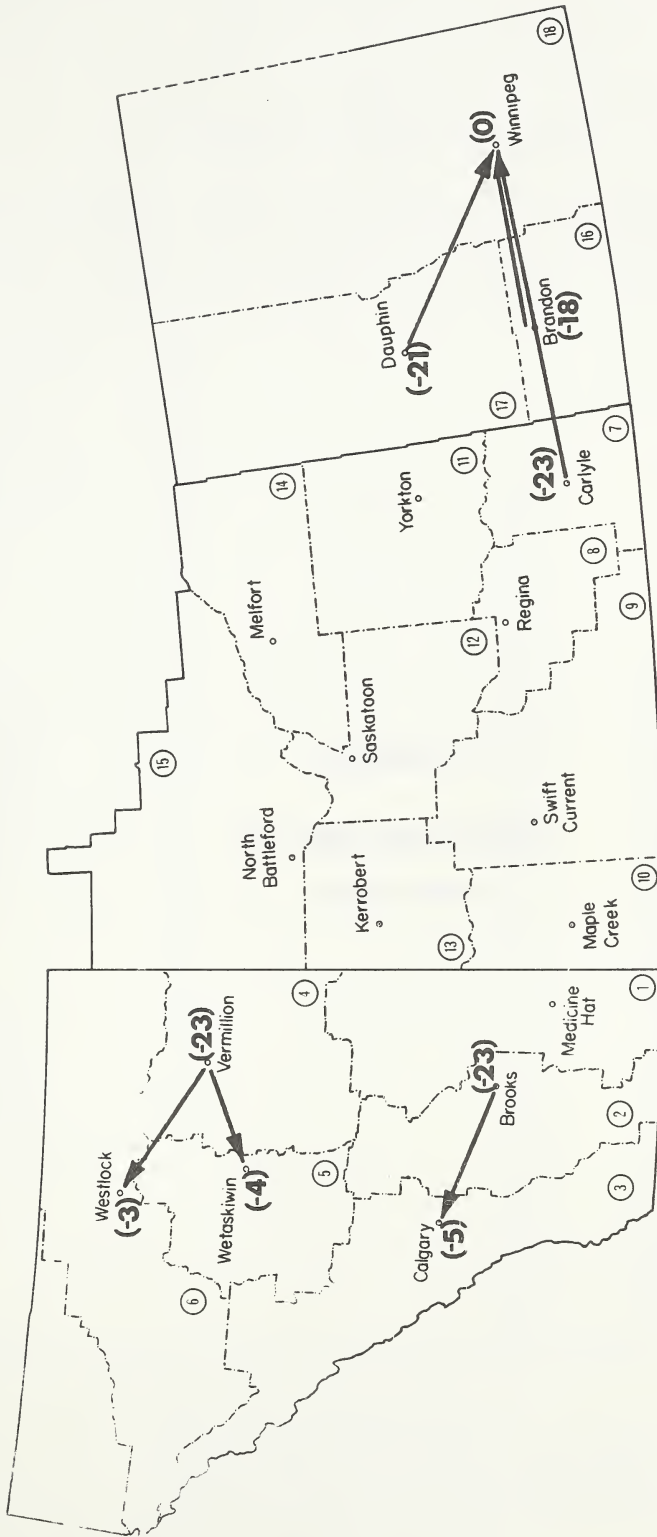


GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL IV, 1968-69

*Note: Numbers in parentheses indicate dual prices.*







GEOGRAPHICAL FEED GRAIN MOVEMENTS AND PRICE DIFFERENTIALS: MODEL IV, 1969-70

Note: Numbers in parentheses indicate dual prices.



APPENDIX D

NON-BOARD GRAIN PRICES,

REGION FIVE



Table 1  
BARLEY IN DOLLARS PER BUSHEL<sup>1</sup>

Time	Camrose <sup>2</sup>	Stony Plain <sup>3</sup>	Edmonton <sup>4</sup>	Warburg <sup>5</sup>	Edmonton <sup>6</sup>
August, 1967	1.00				1.00
September	1.00	1.00			0.95
October	1.00				
November	1.00				0.90
December	1.00	0.95			
January, 1968	1.00		0.90		0.90
February	0.95	1.00	0.90		0.90
March	0.95		0.95		0.90
April	0.95		0.95		0.90
May	0.95	1.00	0.90		
June	0.95		1.90		0.90
July	0.95		0.90		0.90
August	0.85	1.00	0.85	0.95	
September	0.85		0.90	0.90	0.90
October	0.85		0.90	0.90	
November	0.85	0.90	0.90	0.90	
December	0.85		0.90	0.85	0.85
January, 1969	0.85		0.80	0.85	
February	0.70		0.80	0.86	
March	0.70		0.75	0.80	0.80
April	0.70	0.85	0.80	0.85	0.85
May	0.70		0.75	0.85	0.75
June	0.70		0.75	0.80	
July	0.70		0.70	0.80	
August	0.50	0.85	0.70	0.75	
September	0.50		0.70	0.70	0.65
October	0.50	0.85	0.65	0.60	0.65
November	0.50		0.60	0.60	0.65
December	0.50		0.60	0.60	0.65
January, 1970	0.50		0.65	0.60	
February		0.80	0.60	0.60	
March			0.50	0.60	
April			0.60	0.60	
May			0.50	0.60	
June			0.60	0.60	
July			0.60	0.60	

<sup>1</sup>Basis No. 1 feed barley

<sup>2</sup>Source: Rural Feed Mills Association

<sup>3</sup>Source: Rural Feed Mills Association

<sup>4</sup>Source: Company invoices

<sup>5</sup>Source: Company invoices

<sup>6</sup>Source: Canadian Wheat Board



Table 2  
OATS IN DOLLARS PER BUSHEL<sup>1</sup>

Time	Camrose <sup>2</sup>	Stony Plain <sup>3</sup>	Edmonton <sup>4</sup>	Warburg <sup>5</sup>	Edmonton <sup>6</sup>
August, 1967	0.75				
September	0.75	0.65			0.70
October	0.75				
November	0.75				0.60
December	0.75	0.65			
January, 1968	0.75		0.65		0.65
February	0.70	0.65	0.70		0.65
March	0.70		0.70		0.70
April	0.70		0.70		
May	0.70	0.70	0.70		0.65
June	0.70		0.75		
July	0.70		0.70		0.75
August	0.60	0.70	0.75	0.70	
September	0.60		0.70	0.64	0.75
October	0.60		0.75	0.60	
November	0.60	0.65	0.70	0.60	
December	0.60		0.65	0.60	0.60
January, 1969	0.60		0.64	0.60	
February	0.55	0.60	0.60	0.60	
March	0.55		0.60	0.60	0.60
April	0.55	0.65	0.60	0.60	
May	0.55		0.55	0.60	
June	0.55		0.55		
July	0.55		0.55	0.60	
August	0.40	0.55	0.55	0.55	0.60
September	0.40		0.55		
October	0.40	0.55	0.55		
November	0.40		0.55		
December	0.40		0.55		
January, 1970	0.40		0.55		
February		0.50	0.55		
March			0.40	0.40	
April			0.40	0.40	
May			0.40	0.40	
June			0.40	0.40	
July			0.40	0.40	

<sup>1</sup>Basis No. 1 feed oats

<sup>2</sup>Source: Rural Feed Mills Association

<sup>3</sup>Source: Rural Feed Mills Association

<sup>4</sup>Source: Company invoices

<sup>5</sup>Source: Company invoices

<sup>6</sup>Source: Canadian Wheat Board





Table 3  
WHEAT IN DOLLARS PER BUSHEL<sup>1</sup>

Time	Camrose <sup>2</sup>	Stony Plain <sup>3</sup>	Edmonton <sup>4</sup>	Warburg <sup>5</sup>	Edmonton <sup>6</sup>
August, 1967	1.50				
September	1.50	1.65			1.65
October	1.50				
November	1.50				1.65
December	1.50	1.65			
January, 1968	1.50		1.55		
February	1.35	1.40	1.55		
March	1.35		1.55		1.60
April	1.35		1.50		1.55
May	1.35	1.60	1.50		
June	1.35		1.55		1.55
July	1.35		1.55		1.55
August	1.25	1.50	1.50	1.00	
September	1.25		1.45	1.25	1.55
October	1.25		1.45	1.30	1.30
November	1.25	1.40	1.40	1.30	
December	1.25		1.35	1.30	
January, 1969	1.25		1.30		1.25
February	1.15	1.30	1.25	1.20	
March	1.15		1.25	1.20	1.20
April	1.15	1.30	1.20	1.25	1.20
May	1.15		1.15	1.30	1.15
June	1.15		1.10		1.00
July	1.15		1.05	1.00	
August	0.90	1.10	1.00	1.00	1.00
September	0.90		1.00	1.10	1.10
October	0.90	0.90	0.85	1.00	1.10
November	0.90		0.85		1.10
December	0.90		0.85	0.80	1.10
January, 1970	0.90		0.85	0.80	
February		0.82	0.80		
March			0.75	0.80	
April			0.75	0.80	
May			0.80	0.80	
June			0.85	0.80	
July			0.85	0.80	

<sup>1</sup>Basis No. 5 wheat

<sup>2</sup>Source: Rural Feed Mills Association

<sup>3</sup>Source: Rural Feed Mills Association

<sup>4</sup>Source: Company invoices

<sup>5</sup>Source: Company invoices

<sup>6</sup>Source: Canadian Wheat Board



## APPENDIX E



# QUESTIONNAIRE: DESIGN AND RESULTS

The following questionnaire appeared in five papers having a majority of subscribers in rural areas. The survey was conducted during June and July of 1971. A copy of the questionnaire appears below:

1. Do you feel that restrictions on interprovincial movement of feed grains will have any long run effects on Prairie agriculture?

Yes \_\_\_\_ No \_\_\_\_

2. Do you feel that these restrictions have any effect on feed grain prices?

Increase \_\_\_\_ Decrease \_\_\_\_ No effect \_\_\_\_

3. Do you feel that these restrictions affect your farm or business?

Yes \_\_\_\_ No \_\_\_\_

If yes, how? \_\_\_\_\_

4. If you finish cattle, what percentage of your feed grain is home-grown?

0% \_\_\_\_ 25% \_\_\_\_ 50% \_\_\_\_ 75% \_\_\_\_ 100% \_\_\_\_

Address \_\_\_\_\_

Type of farm or business \_\_\_\_\_

A total of sixty-five usable replies were received. Of the questionnaires returned, 51 percent were from Alberta, 24 percent from Saskatchewan, and 25 percent from Manitoba. Of the producers who felt that the restrictions affected their farm operations, 58 percent of those in Alberta, 86 percent of those in Saskatchewan, and 73 percent of those in Manitoba felt that prices of feed grain were decreased as a result.



The low response rate may indicate that:

1. Producers are not concerned about restriction of grains movement interprovincially.
2. The restrictions are not effective and thus transportation of grains is not hindered by the regulation.
3. The results of the survey are spurious.













[illegible]

THESIS	1972	c.2
Bailey, Richard		
AUTHOR	Interregional Feed Grain	
TITLE	Movement	
	c.2.	

### Interregional Feed Grain

c.2.

2

